7
Principles

"… Nothing but confusion can result when order is considered a quality that can equally well be accepted or abandoned, something that can be forgone and replaced by something else. Order must be understood as indispensable to the functioning of any organized system, whether its function be physical or mental. Just as neither an engine nor an orchestra nor a sports team can perform without the integrated cooperation of all its parts, so a work of art or architecture cannot fulfill its function and transmit its message unless it presents an ordered pattern. Order is possible at any level of complexity: in statues as simple as those on Easter Island or as intricate as those by Bernini, in a farmhouse and in a Borromini church. But if there is not order, there is no way of telling what the work is trying to say."

Rudolf Arnheim
The Dynamics of Architectural Form
1977

While Chapter 4 employed a geometric basis for organizing the forms and spaces of a building, this chapter discusses additional principles that can be utilized to create order in an architectural composition. Order refers not simply to geometric regularity, but rather to a condition in which each part of a whole is properly disposed with reference to other parts and to its purpose so as to produce a harmonious arrangement.

There exists a natural diversity and complexity in the program requirements for buildings. The forms and spaces of any building should acknowledge the hierarchy inherent in the functions they accommodate, the users they serve, the purposes or meaning they convey, and the scope or context they address. It is in recognition of this natural diversity, complexity, and hierarchy in the programming, designing, and making of buildings that ordering principles are discussed.

Order without diversity can result in monotony or boredom; diversity without order can produce chaos. A sense of unity with variety is the ideal. The following ordering principles are seen as visual devices that allow the varied and diverse forms and spaces of a building to coexist perceptually and conceptually within an ordered, unified, and harmonious whole.
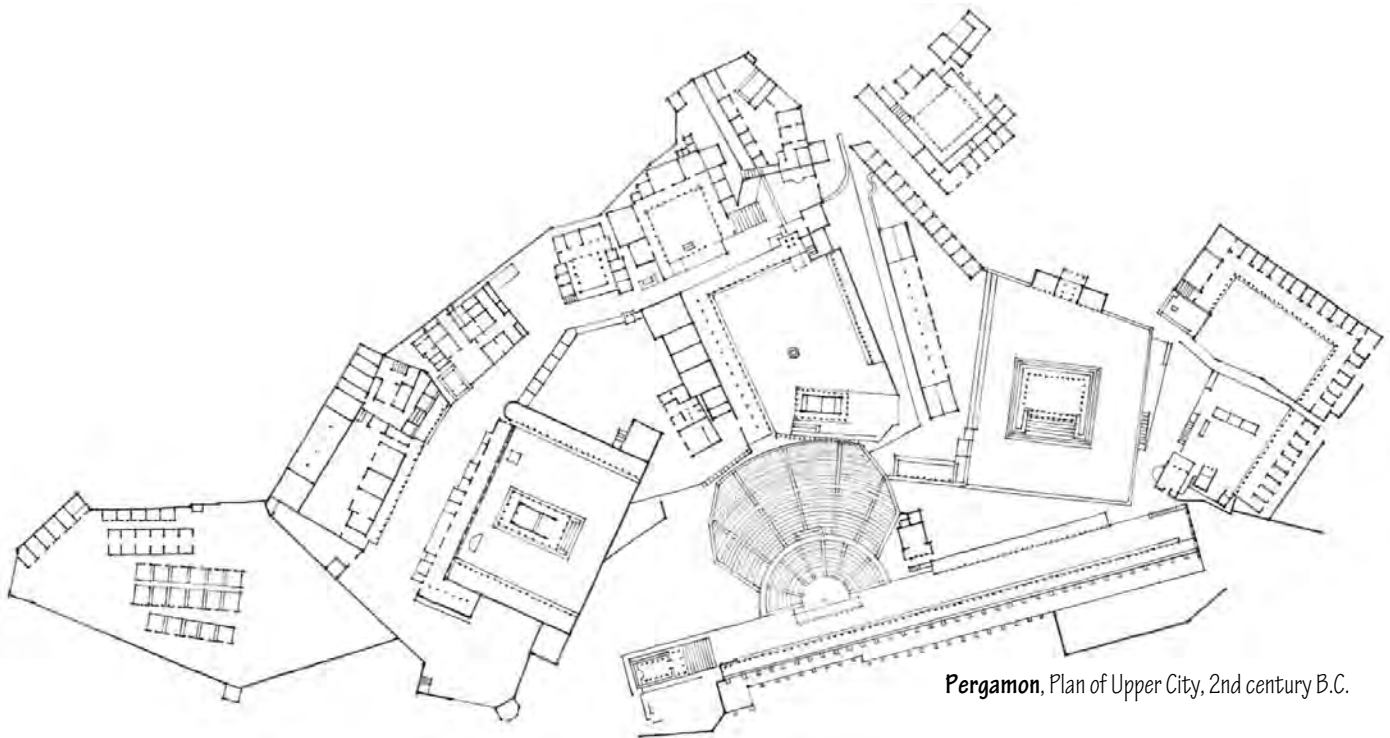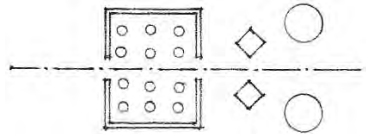
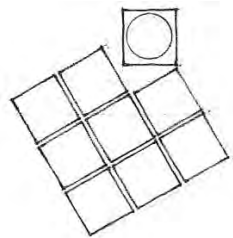**Pergamon**, Plan of Upper City, 2nd century B.C.

Axis

A line established by two points in space, about which forms and spaces can be arranged in a symmetrical or balanced manner.
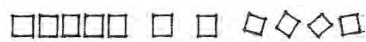
Symmetry

The balanced distribution and arrangement of equivalent forms and spaces on opposite sides of a dividing line or plane, or about a center or axis.
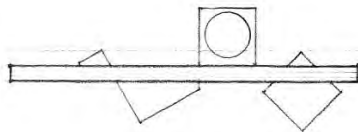
Hierarchy

The articulation of the importance or significance of a form or space by its size, shape, or placement relative to the other forms and spaces of the organization.
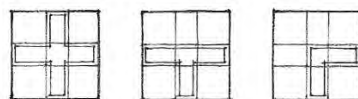
Rhythm

A unifying movement characterized by a patterned repetition or alternation of formal elements or motifs in the same or a modified form.

Datum

A line, plane, or volume that, by its continuity and regularity, serves to gather, measure, and organize a pattern of forms and spaces.

Transformation

The principle that an architectural concept, structure, or organization can be altered through a series of discrete manipulations and permutations in response to a specific context or set of conditions without a loss of identity or concept.

The axis is perhaps the most elementary means of organizing forms and spaces in architecture. It is a line established by two points in space, about which forms and spaces can be arranged in a regular or irregular manner. Although imaginary and not visible except to the mind's eye, an axis can be a powerful, dominating, regulating device. Although it implies symmetry, it demands balance. The specific disposition of elements about an axis will determine whether the visual force of an axial organization is subtle or overpowering, loosely structured or formal, picturesque or monotonous.

This Florentine street flanked by the **Uffizi Palace** links the River Arno to the Piazza della Signoria. See plan on pg. 342.

Since an axis is essentially a linear condition, it has qualities of length and direction, and induces movement and promotes views along its path.

For its definition, an axis must be terminated at both of its ends by a significant form or space.

The notion of an axis can be reinforced by defining edges along its length. These edges can be simply lines on the ground plane, or vertical planes that define a linear space coincident with the axis.
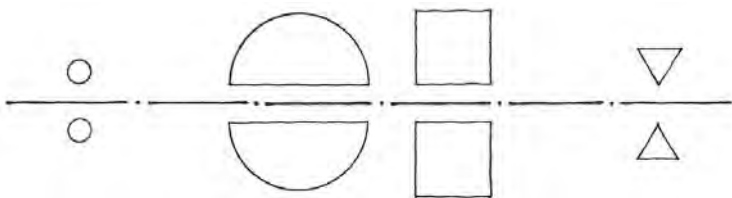
An axis can also be established simply by a symmetrical arrangement of forms and spaces.
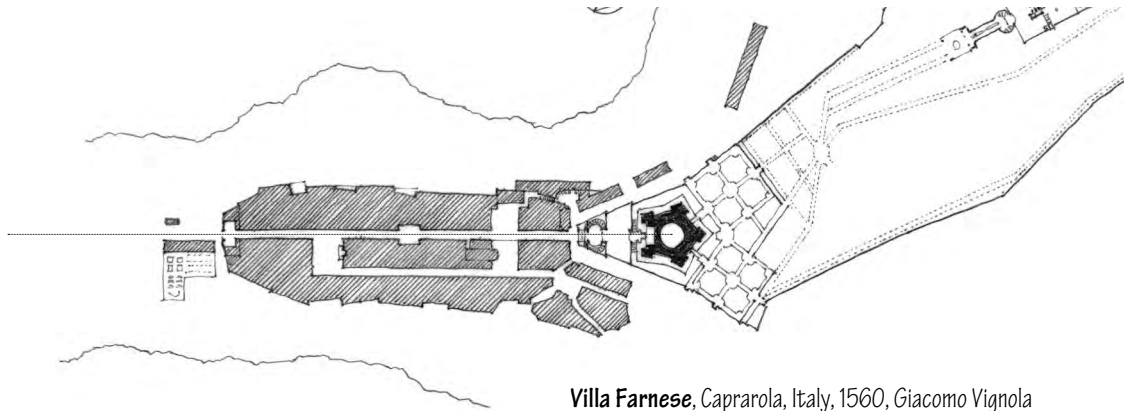
Villa Farnese, Caprarola, Italy, 1560, Giacomo Vignola

The terminating elements of an axis serve to both send and receive its visual thrust. These culminating elements can be any of the following:

• points in space established by vertical, linear elements or centralized building forms

• vertical planes, such as symmetrical building facades or fronts, preceded by a forecourt or similar open space

• well-defined spaces, generally centralized or regular in form

• gateways that open outward toward a view or vista beyond
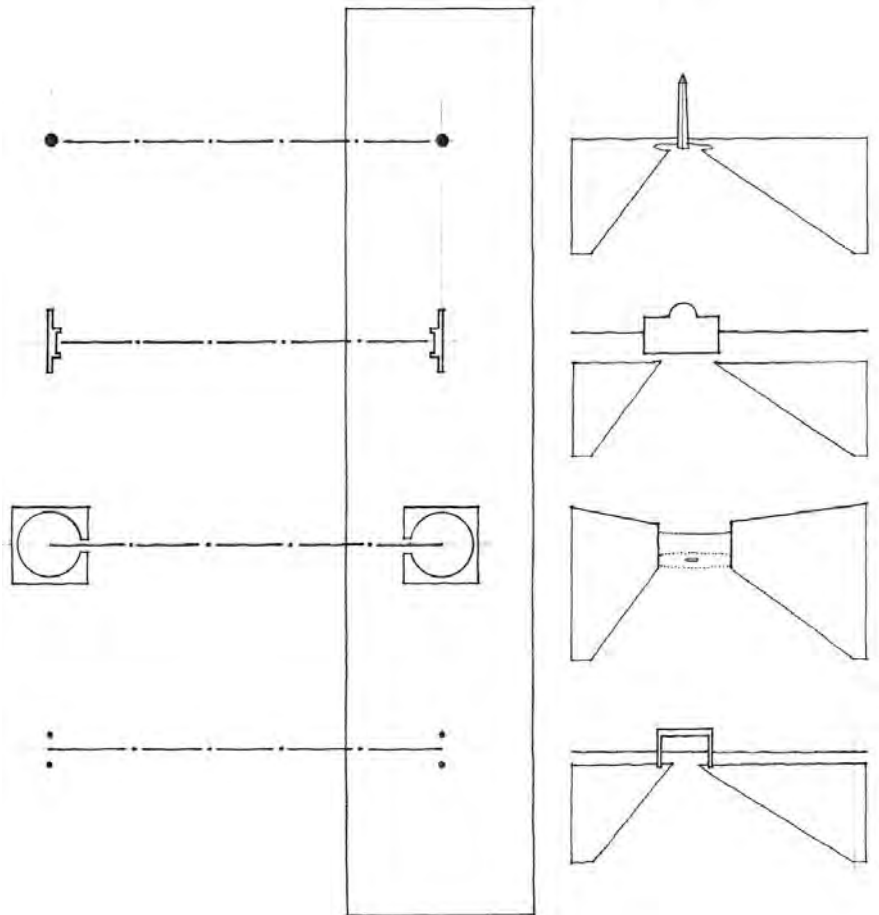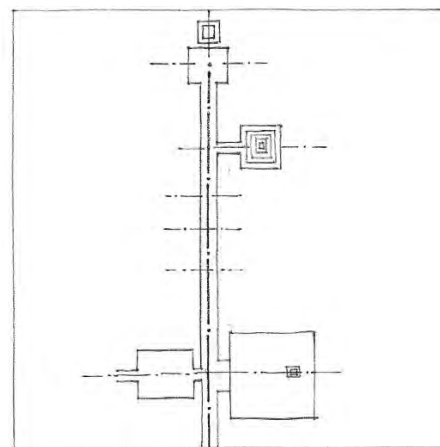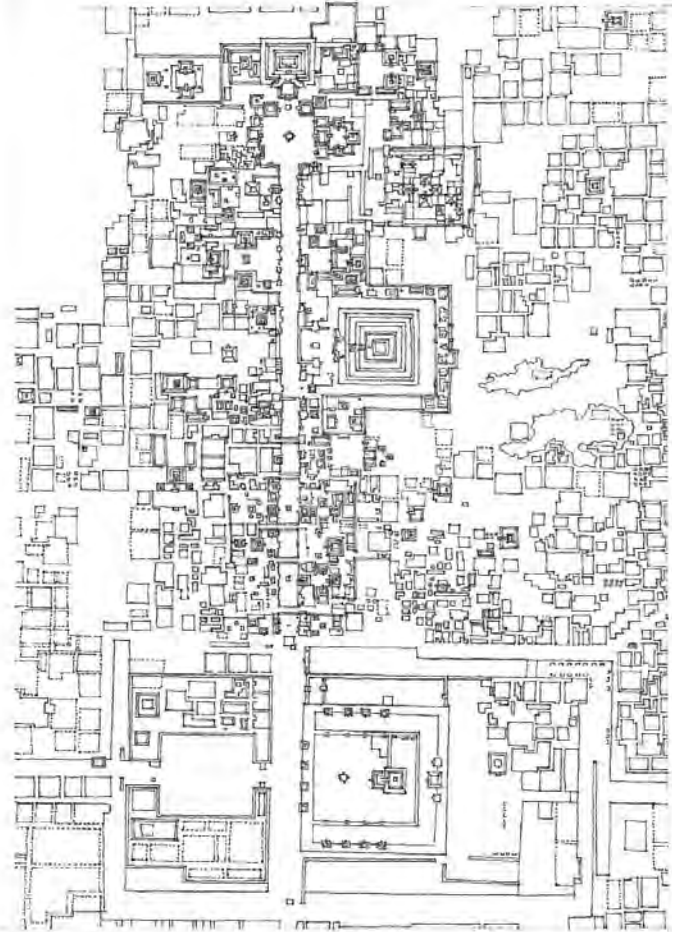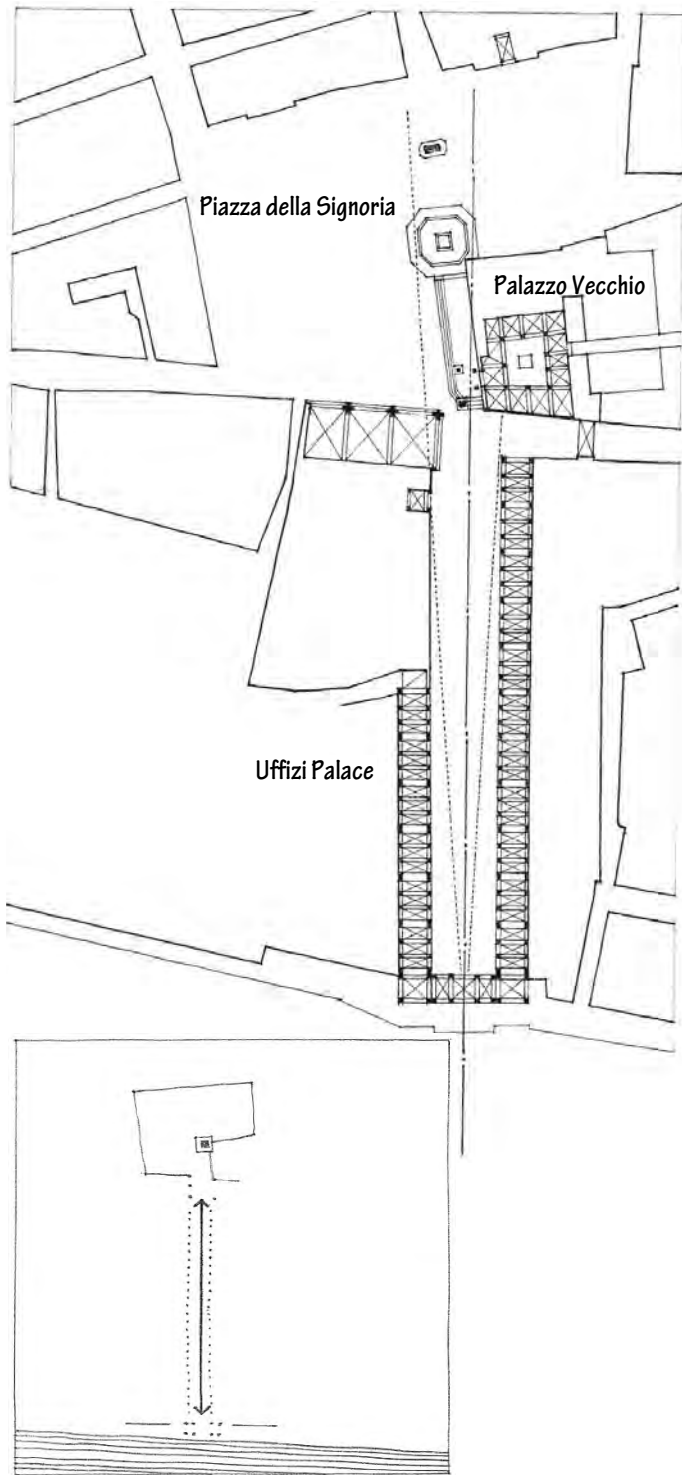
The wings of the **Uffizi Palace** in Florence, Italy, (1560, Giorgio Vasari) frame an axial space that leads from the River Arno, through the Uffizi arch, to the Piazza della Signoria and the **Palazzo Vecchio** (1298–1314, Arnolfo di Cambio).

Teotihuacan, City of the Gods. Located near Mexico city, Teotihuacan was the largest and most influential ritual center of Mesoamerica, founded c. 100 B.C. and flourishing until about A.D. 750. The site was dominated by two massive temple-pyramids, the Pyramid of the Sun and the smaller Pyramid of the Moon, from which the Avenue of the Dead runs south to the citadel and market compound in the center of the city.
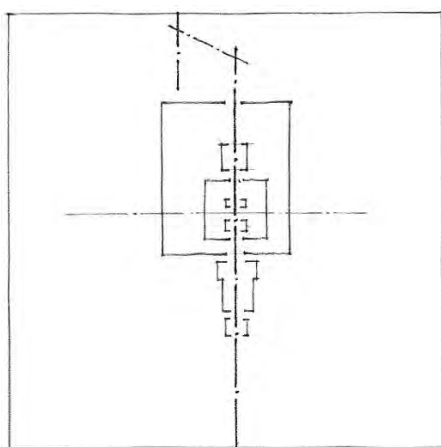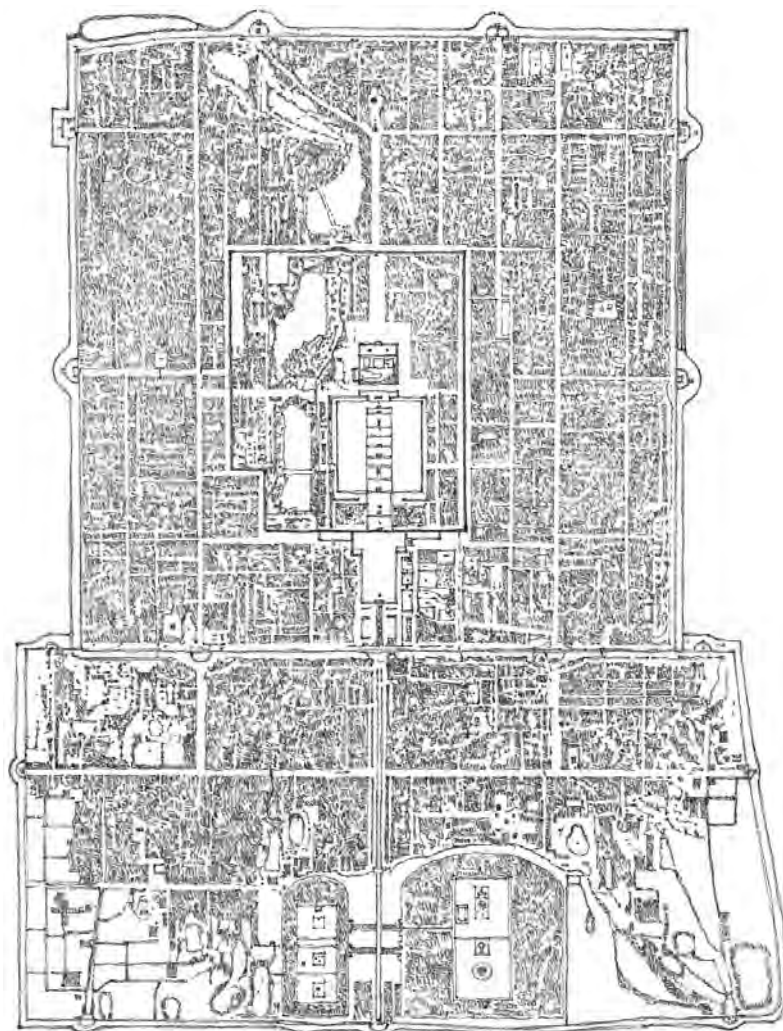
Plan of Beijing, China. Located on its north-south axis is the Forbidden City, a walled section within the inner city, built in the 15th century and containing the Imperial Palace and other buildings of the imperial government of China. It was so named because it was formerly closed to the public.
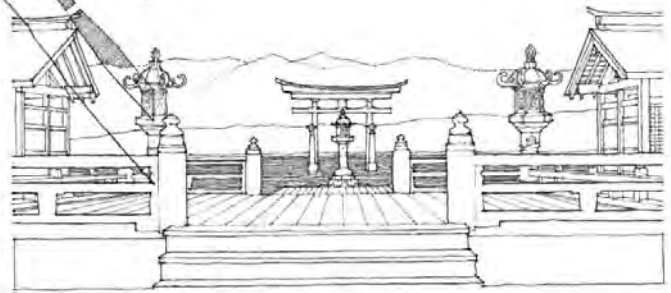
View from the Temple toward the Torii, a symbolic gateway in the sea.

Itsukushima Temple, Hiroshima Prefecture, Japan, 13th century

Torii is a monumental, freestanding gateway on the approach to a Shinto shrine, consisting of two pillars connected at the top by a horizontal crosspiece and a lintel above it, usually curving upward.
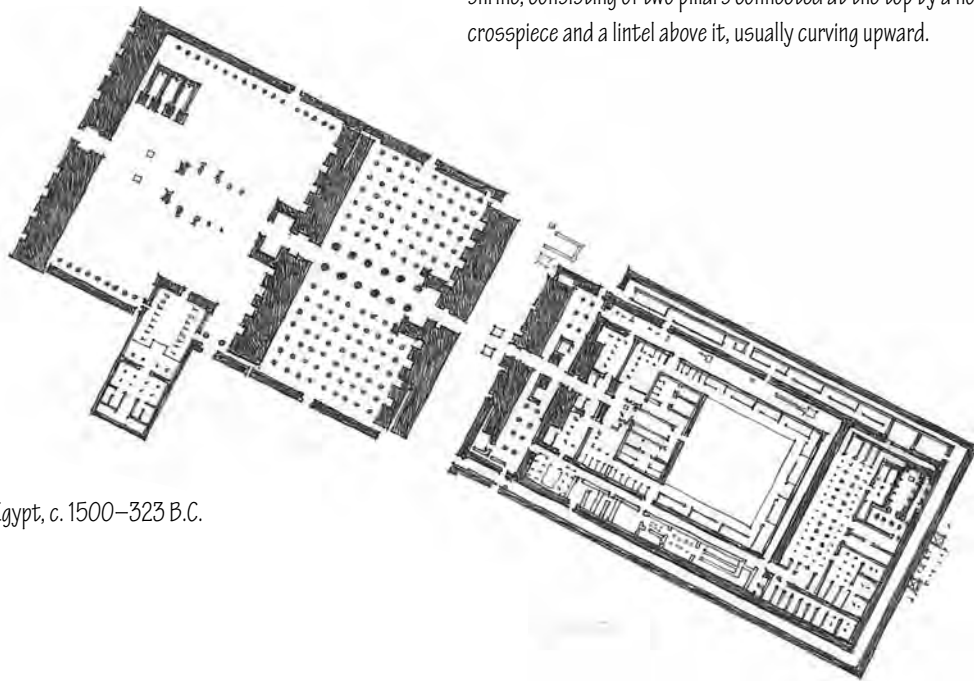
Temple of Amun at Karnak, Egypt, c. 1500–323 B.C.
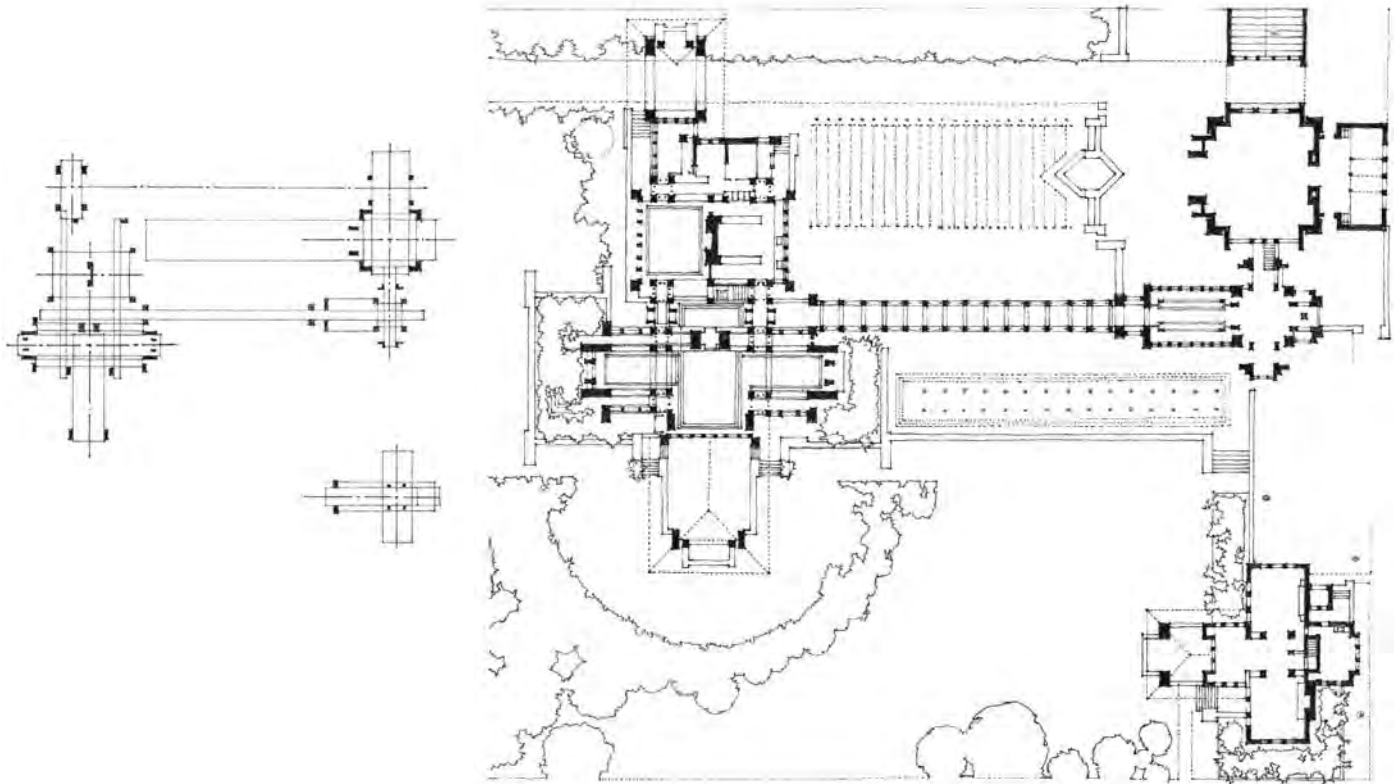
Darwin D. Martin House and Estate, Buffalo, New York, 1904, Frank Lloyd Wright
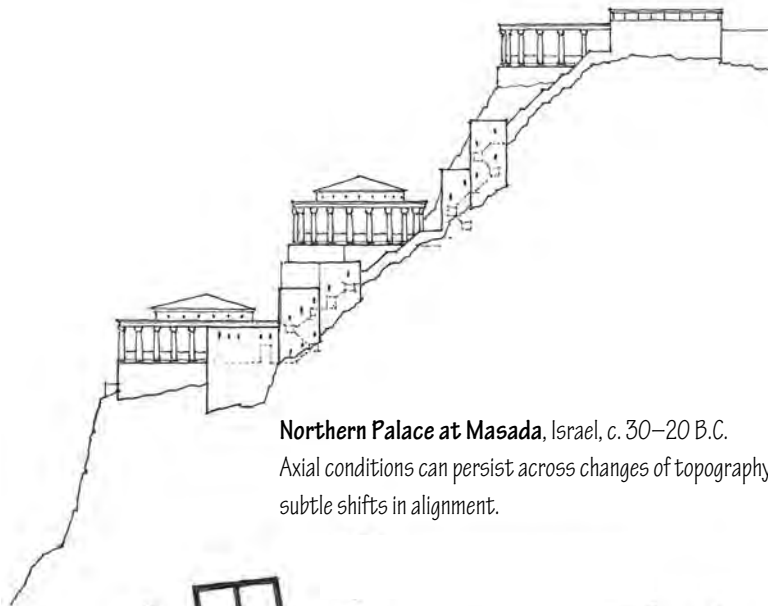
Northern Palace at Masada, Israel, c. 30–20 B.C.
Axial conditions can persist across changes of topography and despite
subtle shifts in alignment.
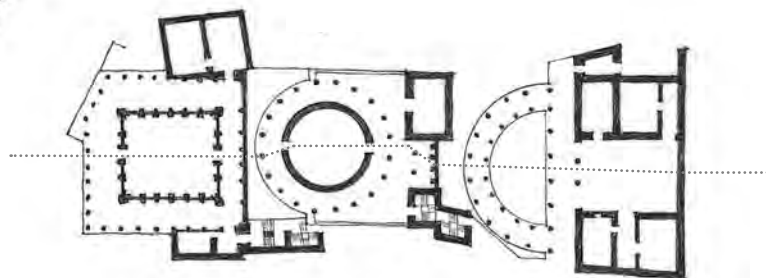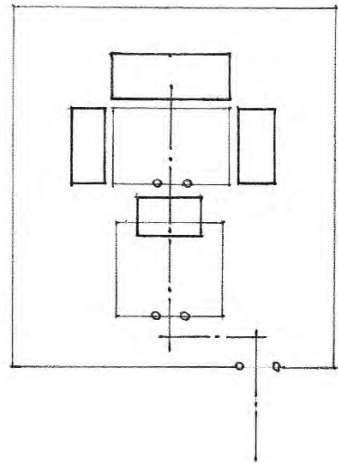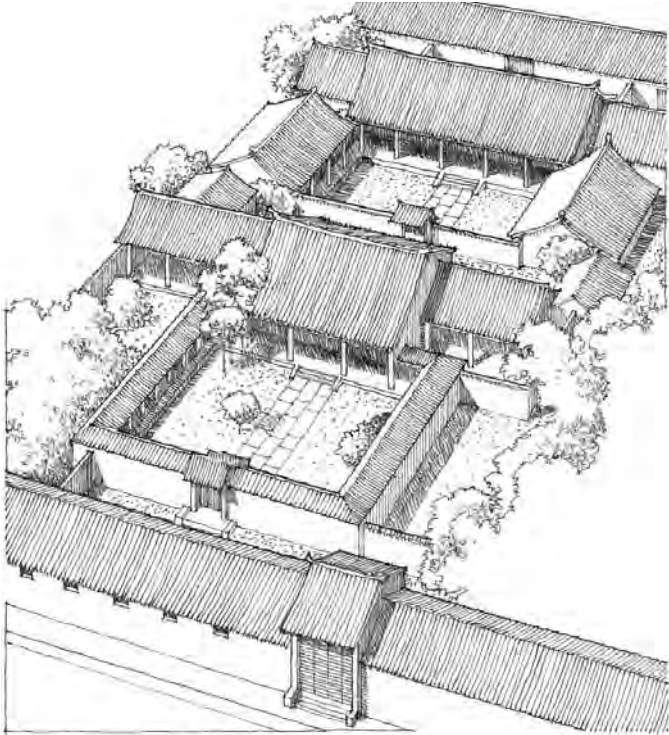
Chinese Courtyard House, Beijing, China
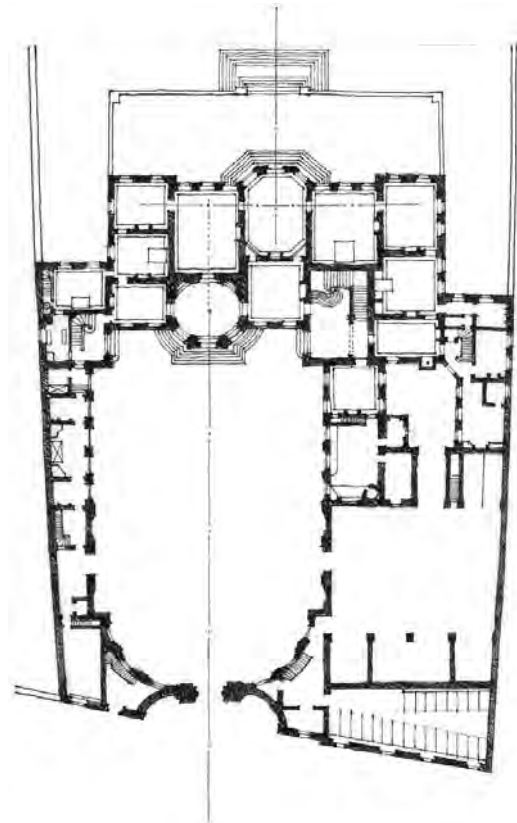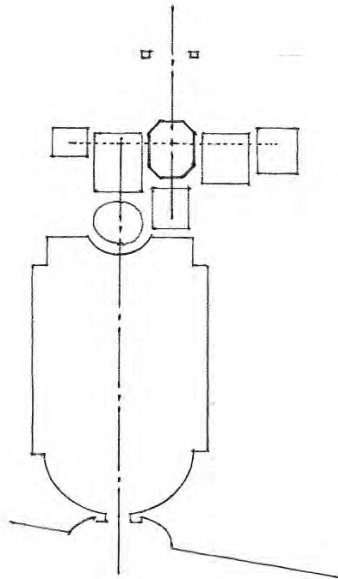
Hôtel de Matignon, Paris, 1721, J. Courtonne
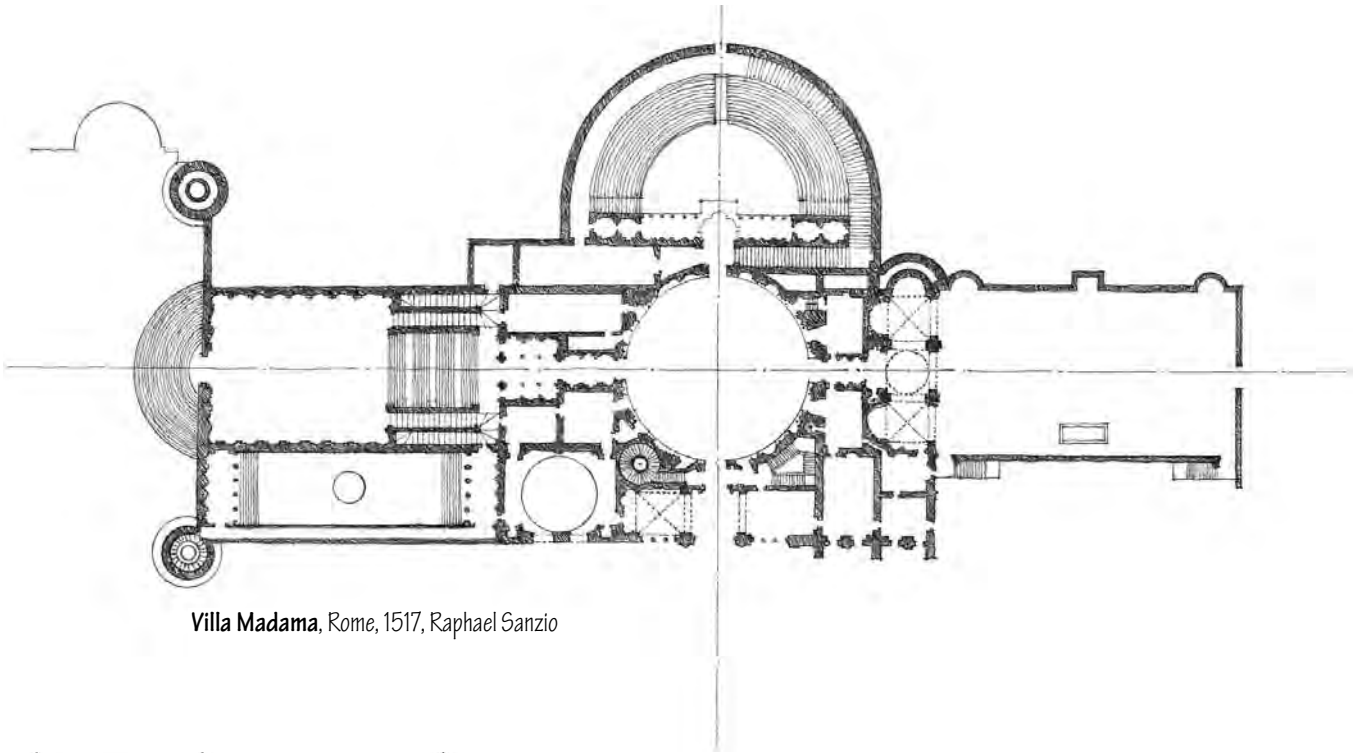
Villa Madama, Rome, 1517, Raphael Sanzio
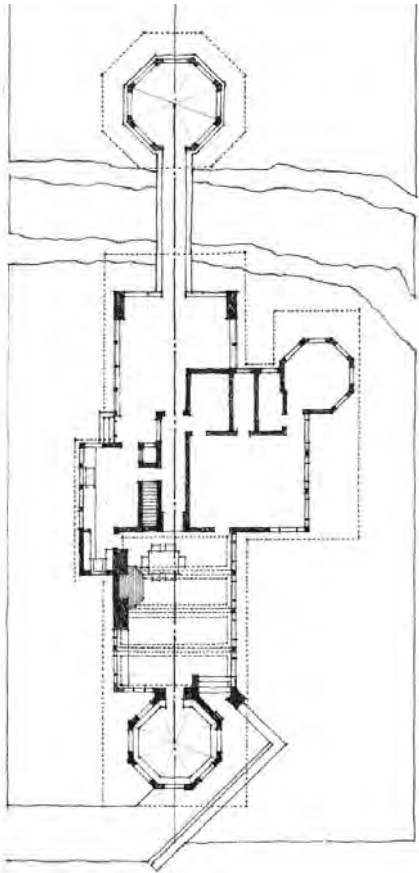
W.A. Glasner House, Glencoe, Illinois, 1905, Frank Lloyd Wright
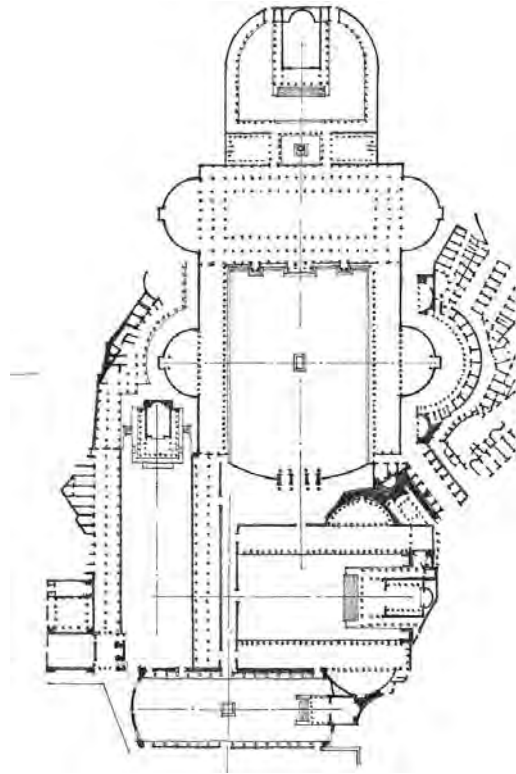
Imperial Forums of Trajan, Augustus, Caesar, and Nerva, Rome, 1st century B.C. to 2nd century A.D.

While an axial condition can exist without a symmetrical condition being simultaneously present, a symmetrical condition cannot exist without implying the existence of an axis or center about which it is structured. An axis is established by two points; a symmetrical condition requires the balanced arrangement of equivalent patterns of form and space on opposite sides of a dividing line or plane, or about a center or axis.

There are two fundamental types of symmetry:

1. Bilateral symmetry refers to the balanced arrangement of similar or equivalent elements on opposite sides of a median axis so that only one plane can divide the whole into essentially identical halves.

2. Radial symmetry refers to the balanced arrangement of similar, radiating elements such that the composition can be divided into similar halves by passing a plane at any angle around a centerpoint or along a central axis.

Plan of an Ideal Church, 1460, Antonio Filarete

Hôtel de Beauvais, Paris, 1656, Antoine Le Pautre

An architectural composition can utilize symmetry to organize its forms and spaces in two ways. An entire building organization can be made symmetrical. At some point, however, any totally symmetrical arrangement must confront and resolve the asymmetry of its site or context.

A symmetrical condition can occur in only a portion of the building and organize an irregular pattern of forms and spaces about itself. The latter case of local symmetry allows a building to respond to exceptional conditions of its site or program. The symmetrical condition itself can be reserved for significant or important spaces within the organization.

Radial symmetry
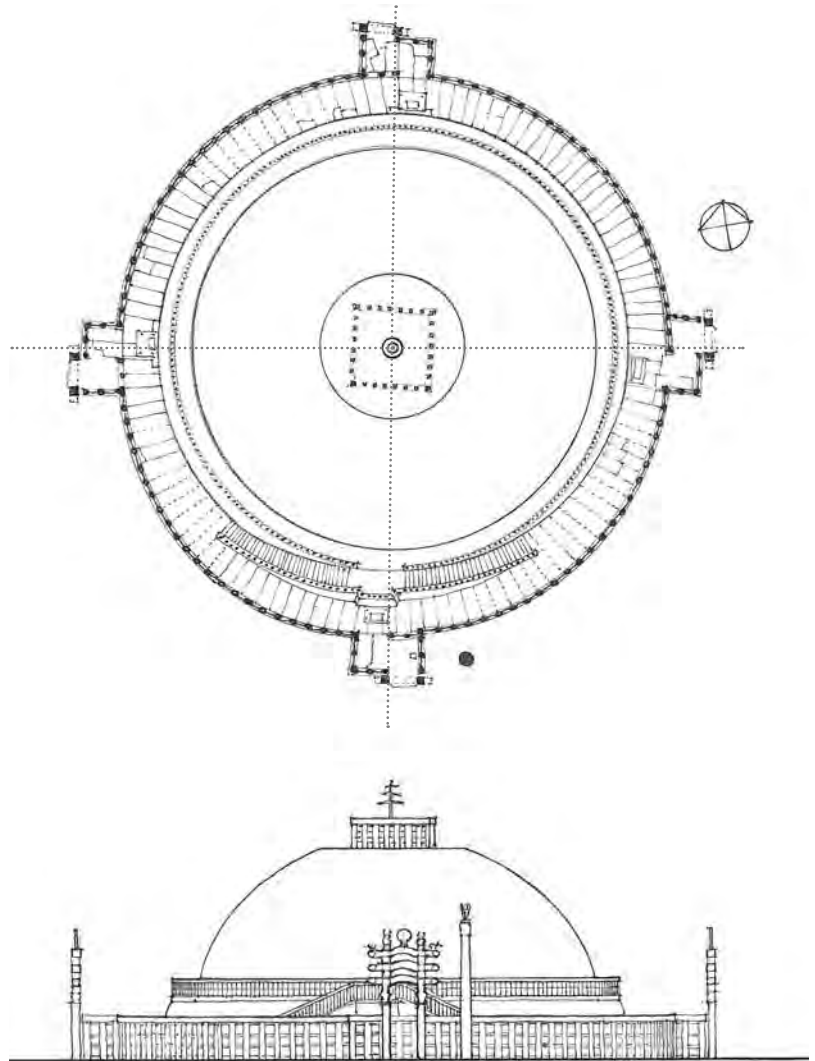
Great Stupa at Sanchi, India, *c. 100 B.C.*

Bilateral symmetry
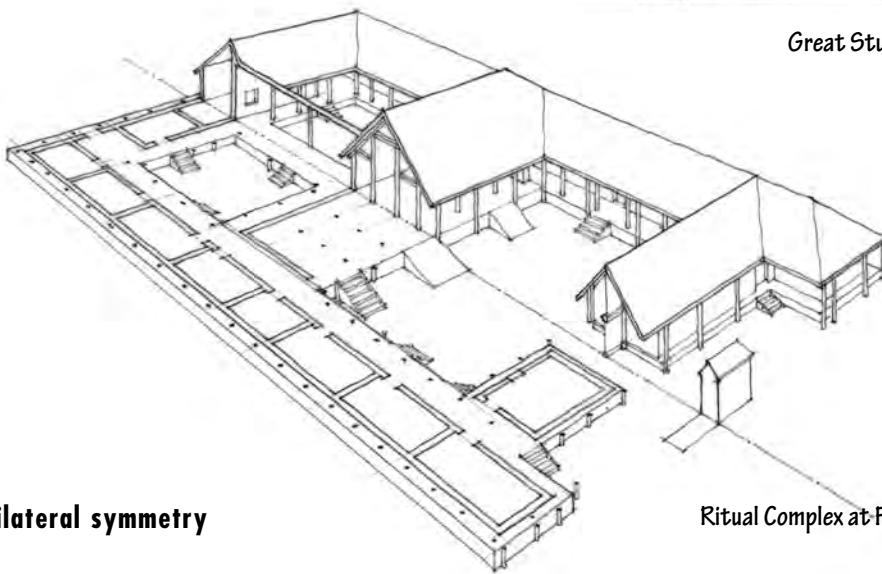
Ritual Complex at Fengchu, *Shaanxi Province, China, c. 1100–1000 B.C.*
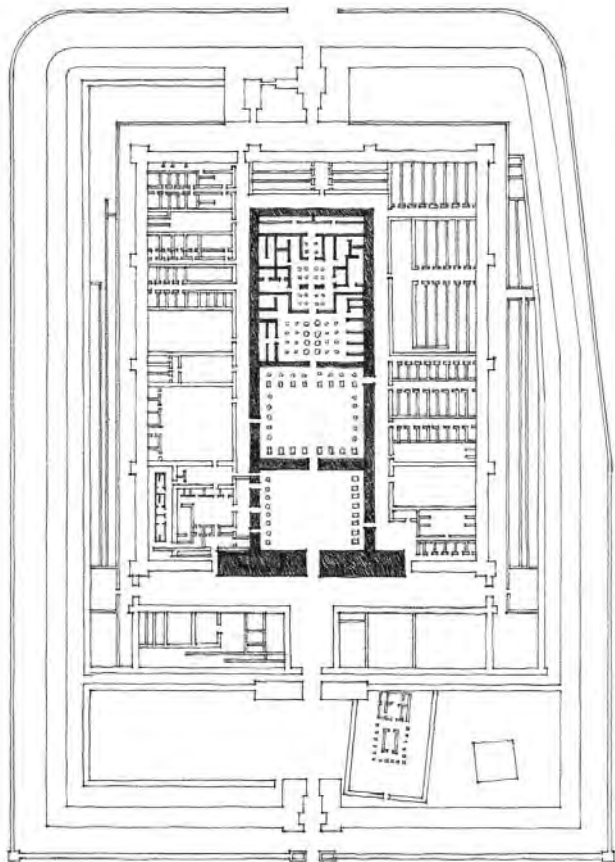
Mortuary Temple of Rameses III, Medînet-Habu, 1198 B.C.
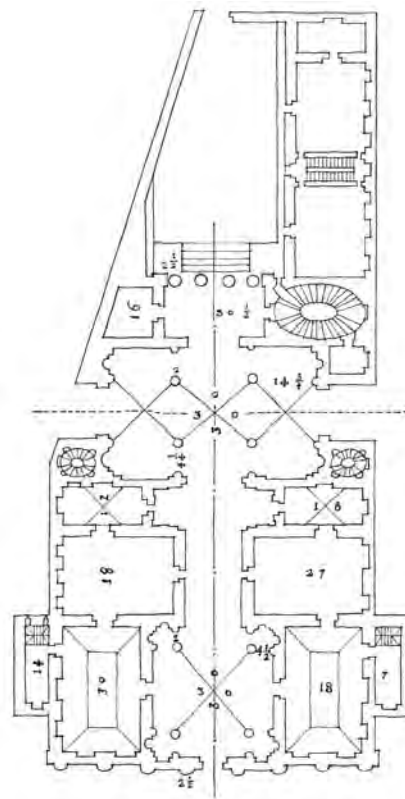
Palazzo No. 52, Andrea Palladio
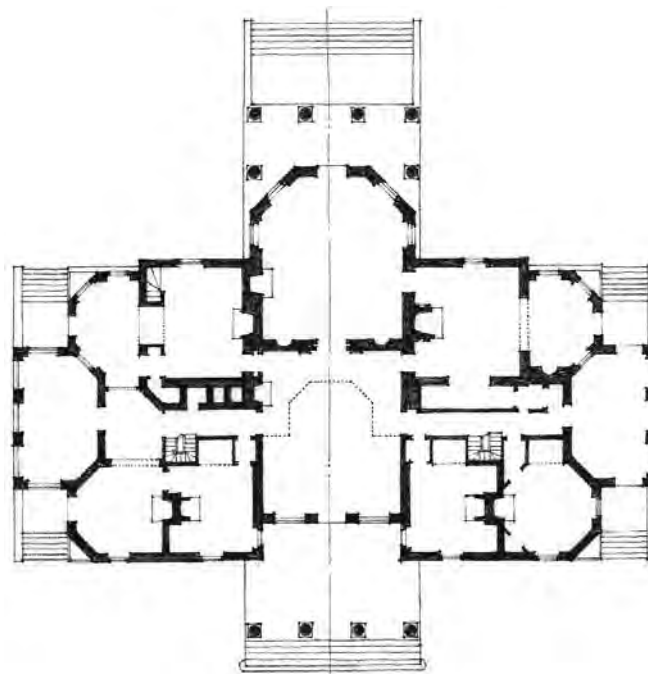
Monticello, near Charlottesville, Virginia, 1770-1808, Thomas Jefferson
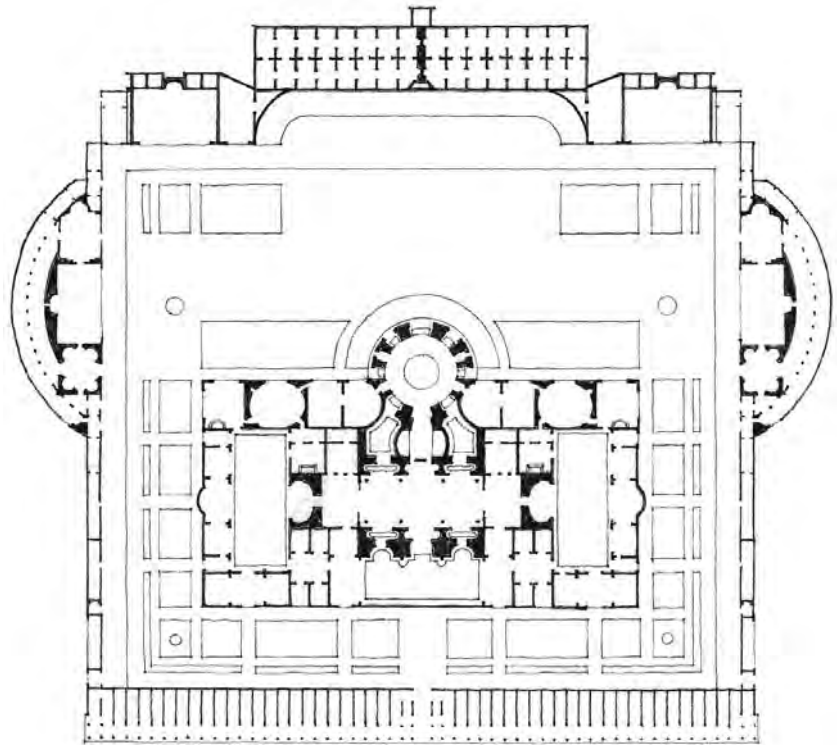
Baths (Thermae) of Caracalla, *Rome, A.D. 211-17*
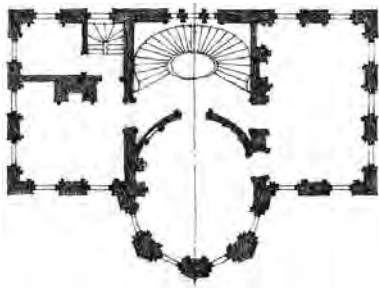
Nathaniel Russell House, *Charleston, South Carolina, 1809*
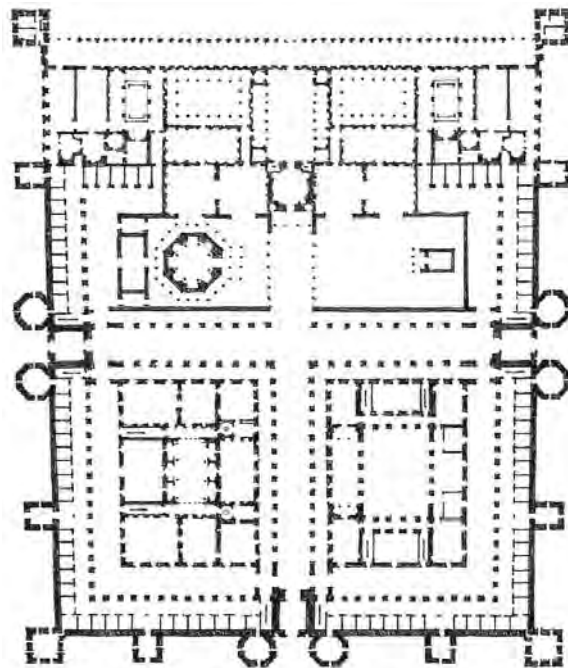
Palace of Diocletian, *Spalato, Yugoslavia, c. A.D. 300*

Half-plan of Main Floor

Half-plan of Balcony
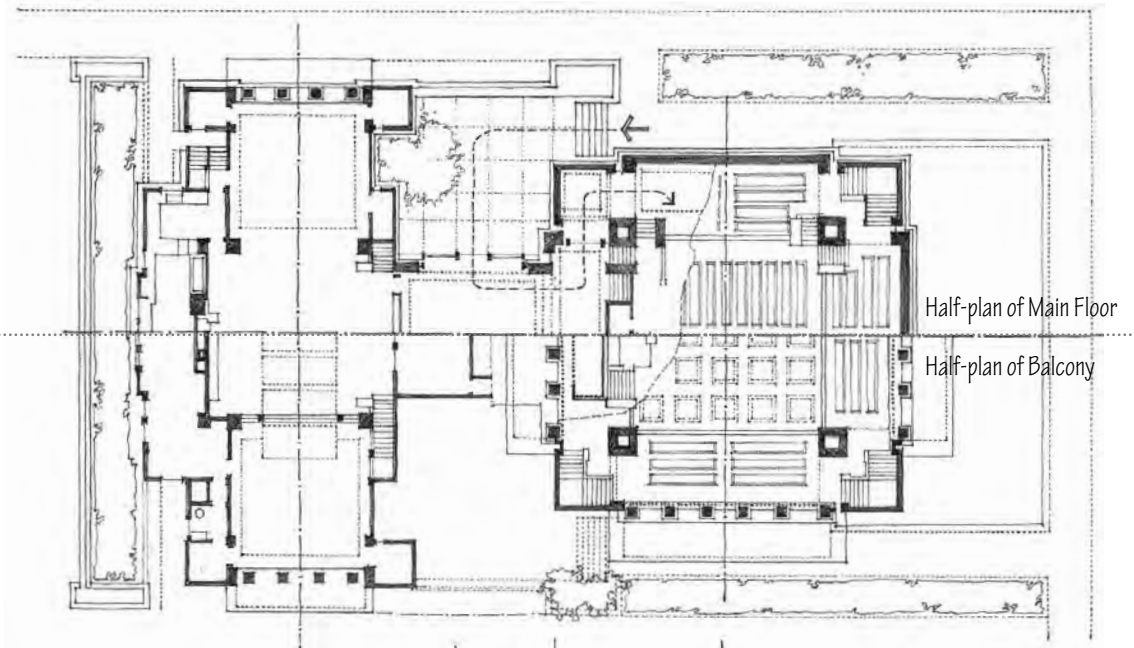
Unity Temple, Oak Park, Illinois, 1905–7, Frank Lloyd Wright
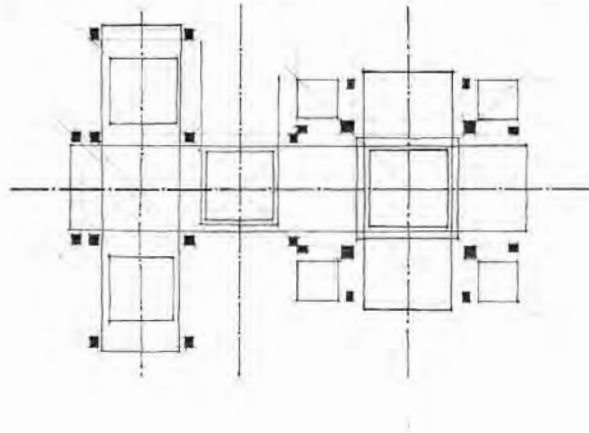
Multiple symmetries, both major and minor, can add complexity and hierarchy to a composition as well as accommodate programmatic and contextual requirements.
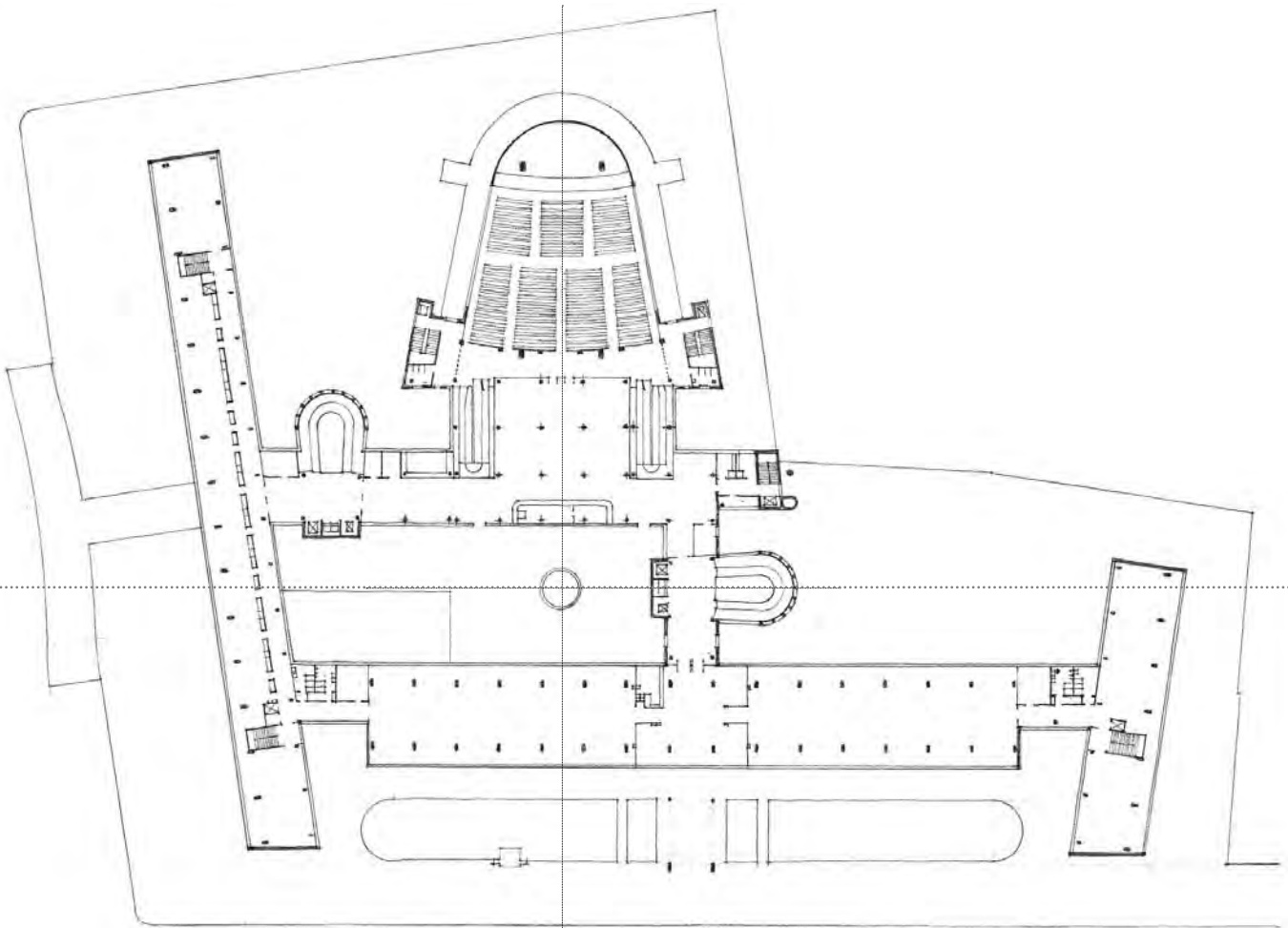
Third Floor Plan, **Centrosoyus Building**, Kirova Ulitsa, Moscow, 1929–33, Le Corbusier
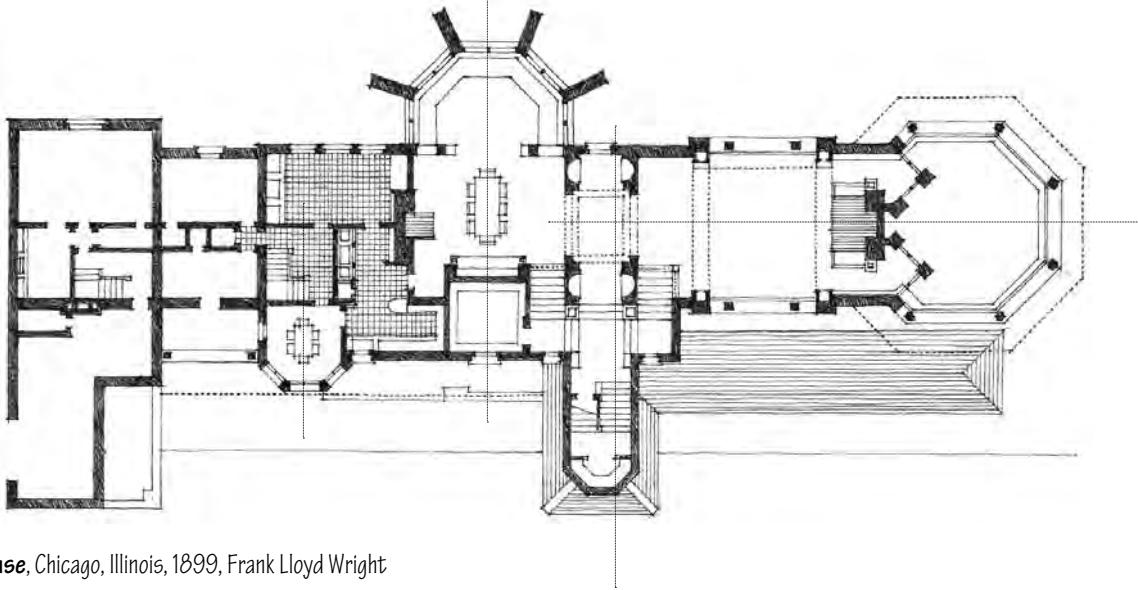
Husser House, Chicago, Illinois, 1899, Frank Lloyd Wright

Palace of the Soviets (Competition), Le Corbusier, 1931
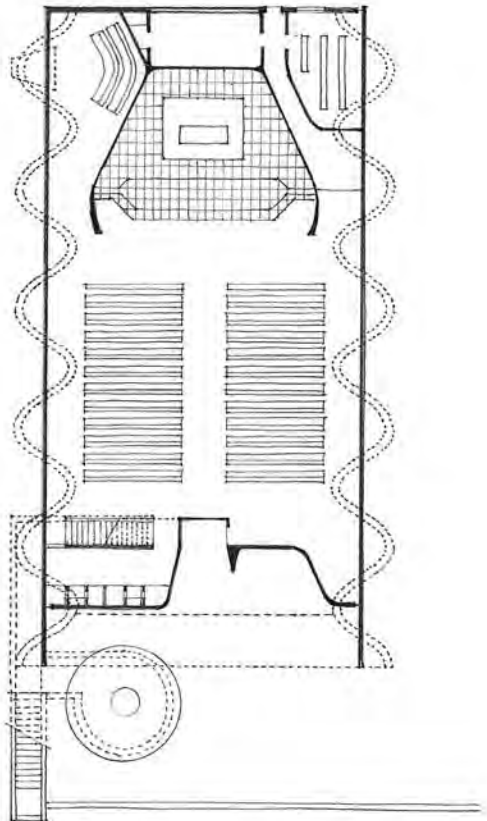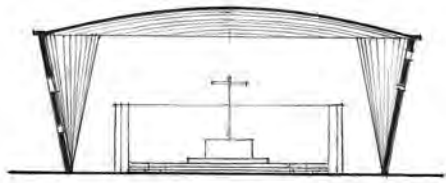
Church of Christ the Worker, Atlántida, Uruguay,
Eladio Dieste, 1958–60
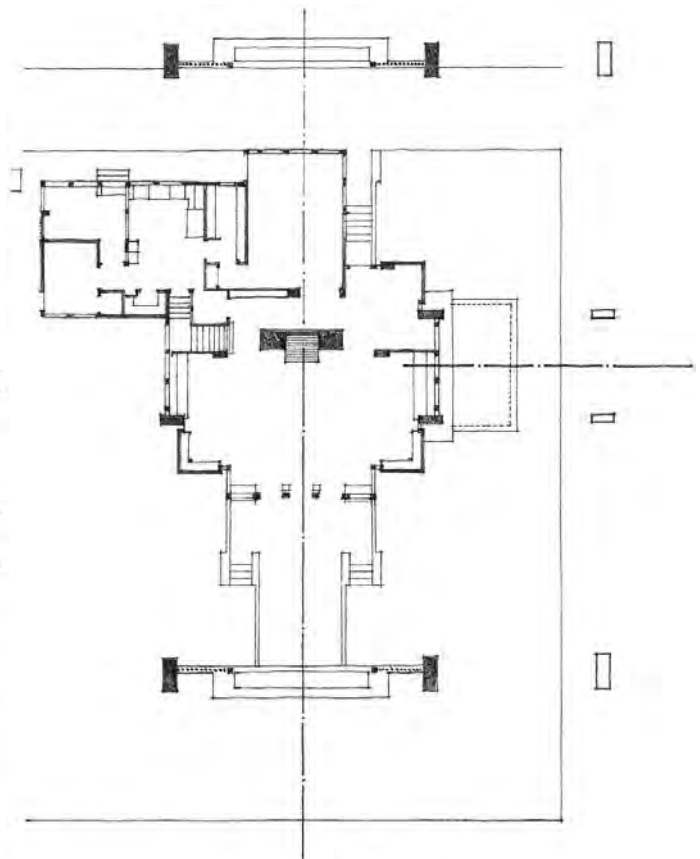
Robert W. Evans House, Chicago, Illinois, 1908, Frank Lloyd Wright
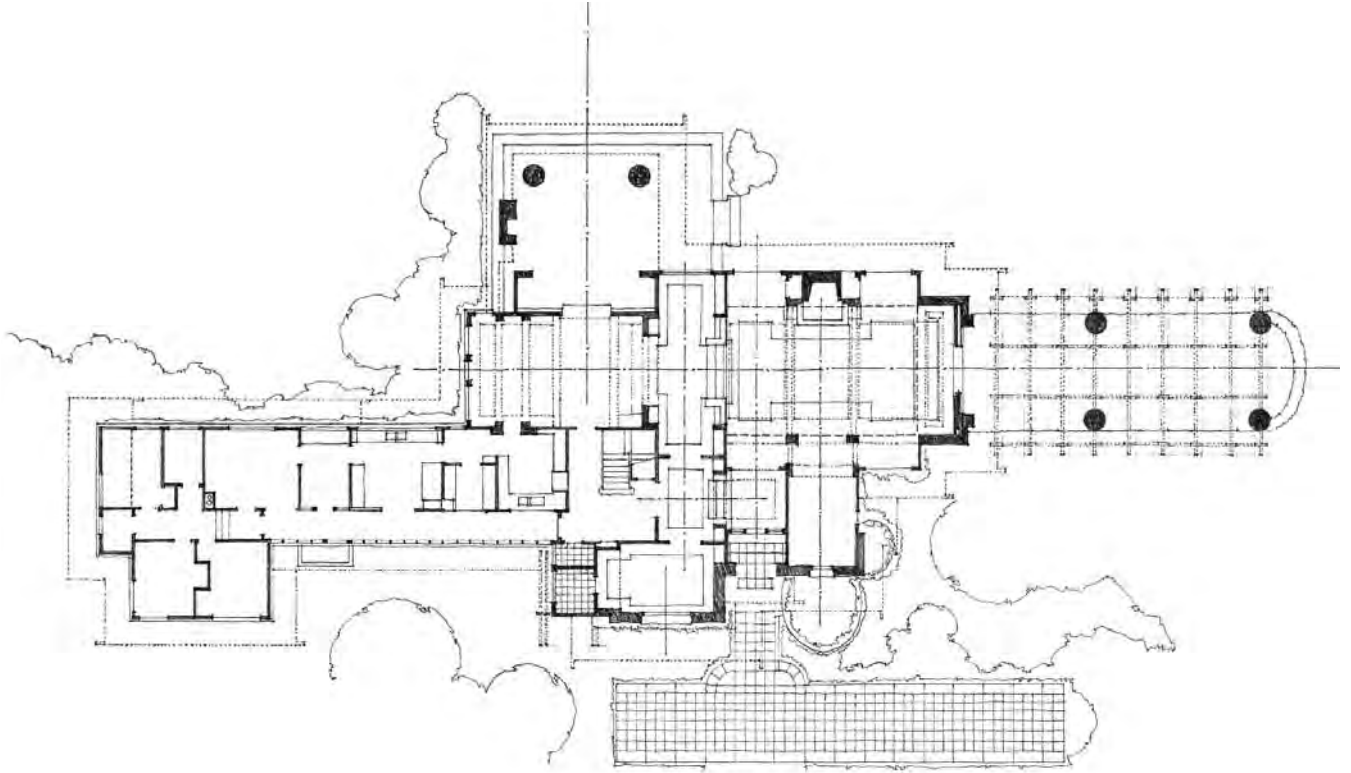
A.E. Bingham House, Near Santa Barbara, California, 1916, Bernard Maybeck
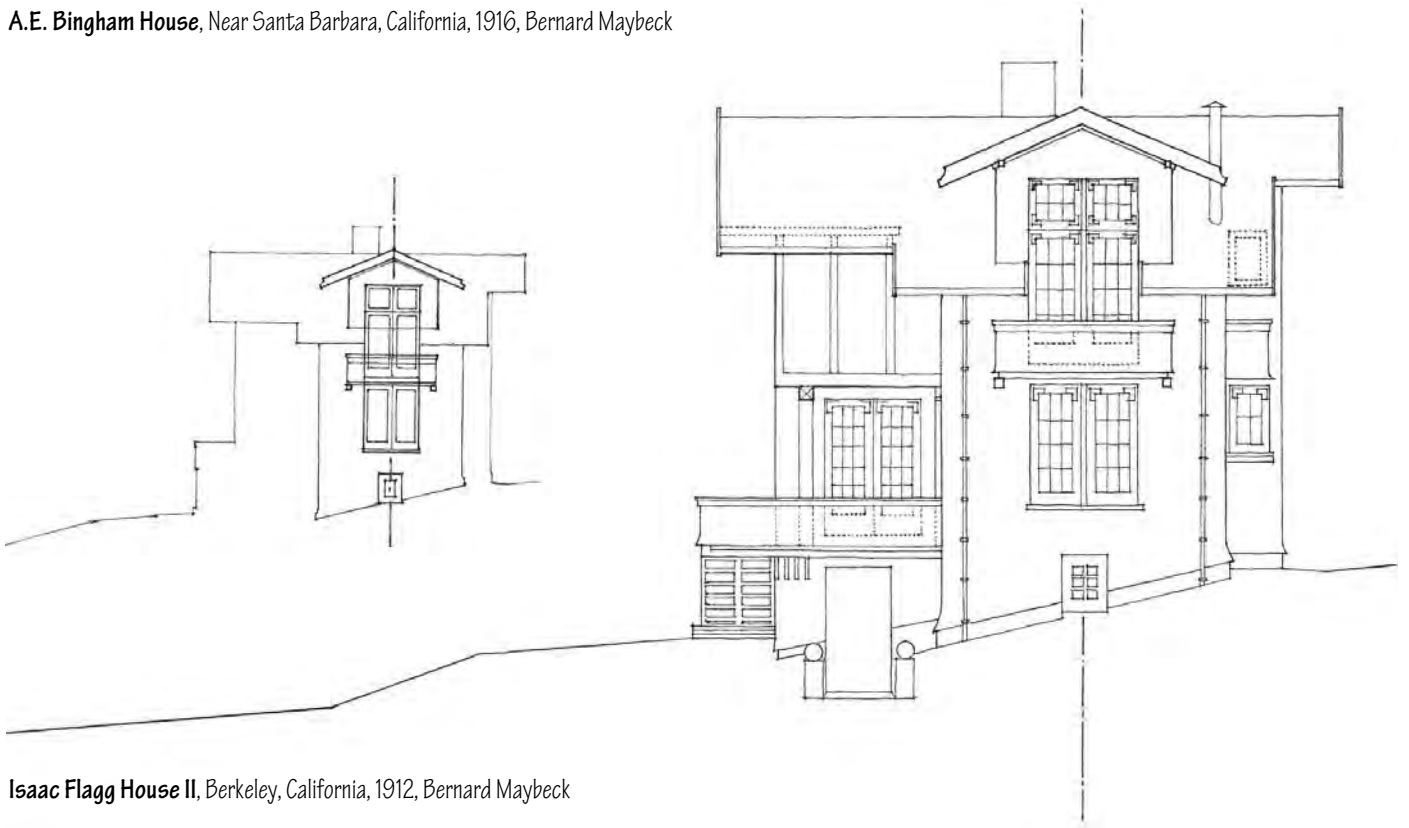
Isaac Flagg House II, Berkeley, California, 1912, Bernard Maybeck
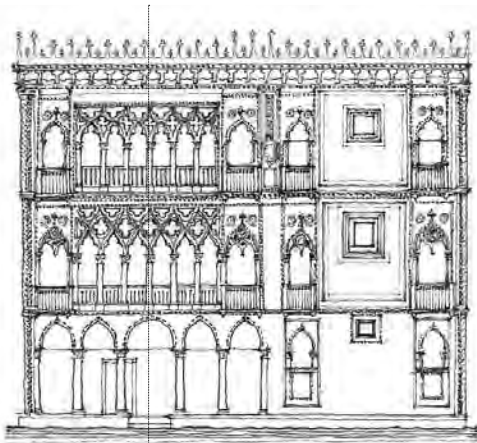
Ca d'Oro, Venice, 1424–36, Giovanni and Bartolomeo Buon

Frank Lloyd Wright Studio,
Oak Park, Illinois, 1889
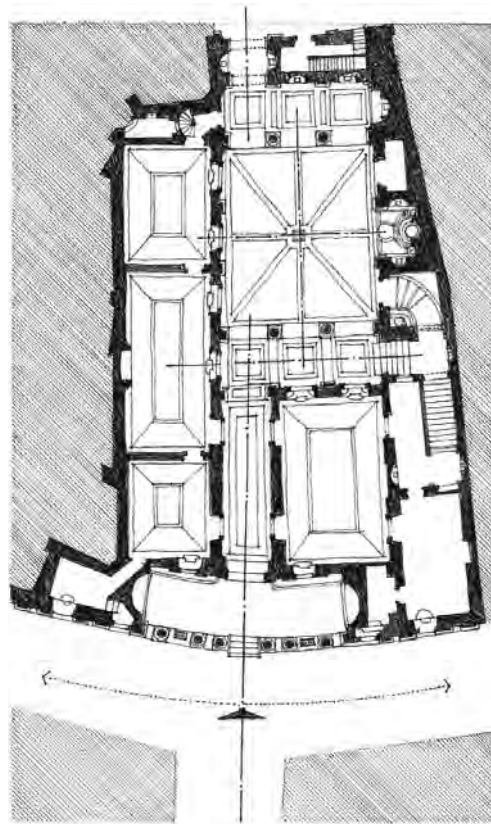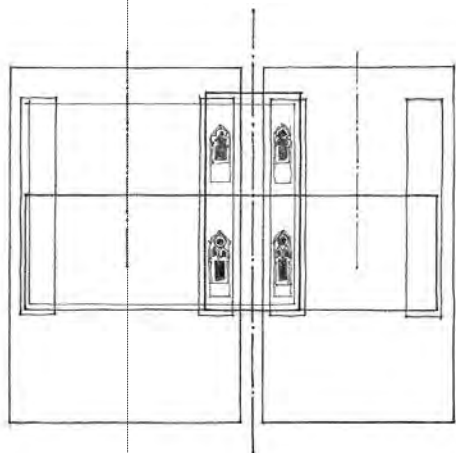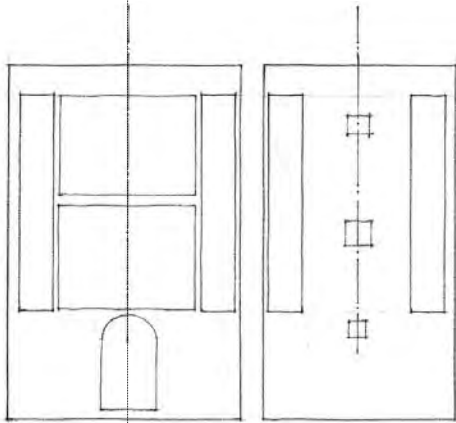
Palazzo Pietro Massimi, Rome, 1532–36, Baldassare Peruzzi. A
symmetrical facade leading into an asymmetrical interior.
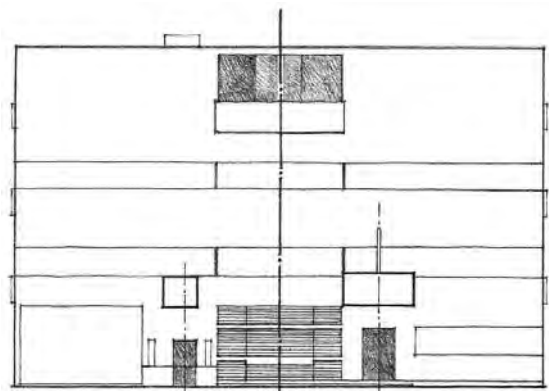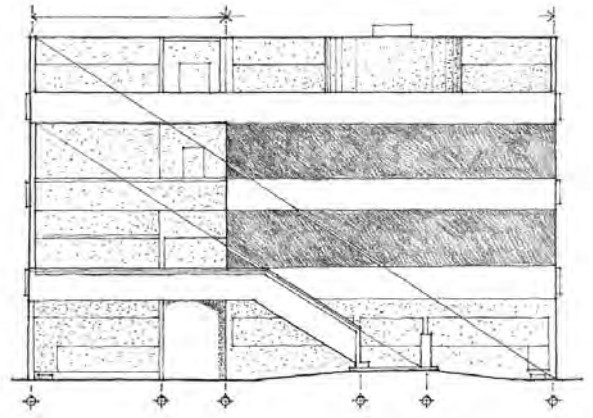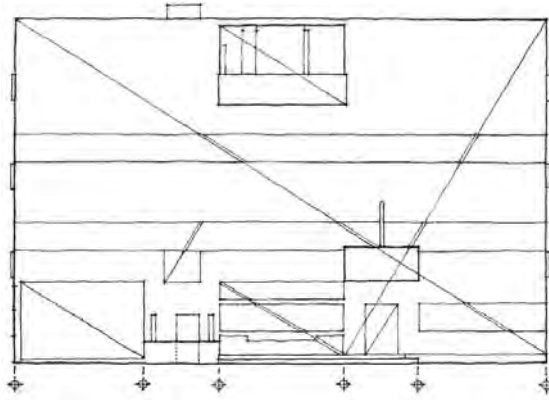
Entrance Facade

Main Entry

Garden Facade

Symmetry of Building Maintained

Approach Axis
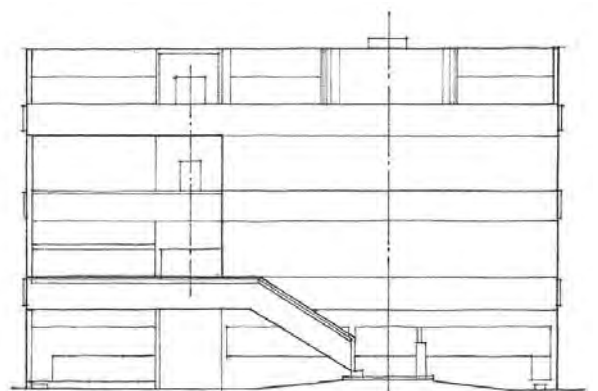
Villa Garches, Vaucresson, France, 1926–27, Le Corbusier
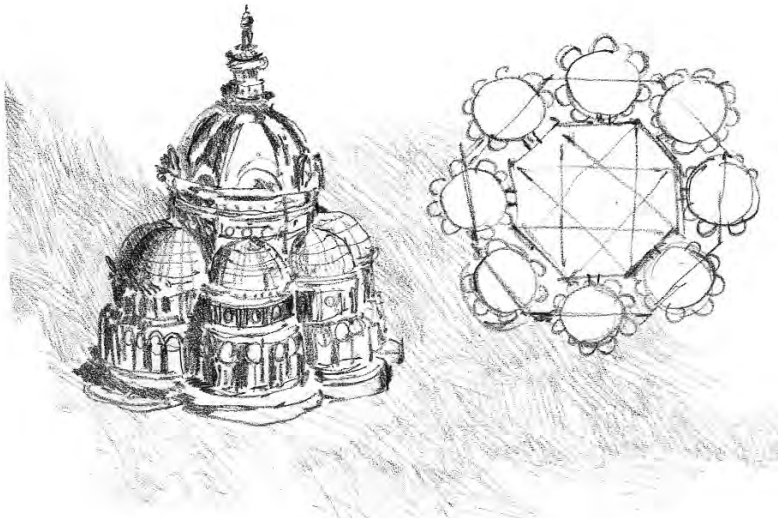
After a sketch of an ideal church by Leonardo da Vinci

The principle of hierarchy implies that in most if not all architectural compositions, real differences exist among their forms and spaces. These differences reflect the degree of importance of these forms and spaces, as well as the functional, formal, and symbolic roles they play in the organization. The value system by which relative importance is measured will of course depend on the specific situation, the needs and desires of the users, and the decisions of the designer. The values expressed may be individual or collective, personal or cultural. In any case, the manner in which the functional or symbolic differences among a building's elements are revealed is critical to the establishment of a visible, hierarchical order among its forms and spaces.

For a form or space to be articulated as being important or significant to an organization, it must be made uniquely visible. This visual emphasis can be achieved by endowing a form or shape with:

• exceptional size
• a unique shape
• a strategic location

In each case, the hierarchically important form or space is given meaning and significance by being an exception to the norm, an anomaly within an otherwise regular pattern.

In an architectural composition, there can be more than a single dominant element. Secondary points of emphasis that have less attention value than the primary focal point create visual accents. These distinctive but subordinate elements can both accommodate variety and create visual interest, rhythm, and tension in a composition. If carried too far, however, this interest may be replaced by confusion. When everything is emphasized, nothing is emphasized.
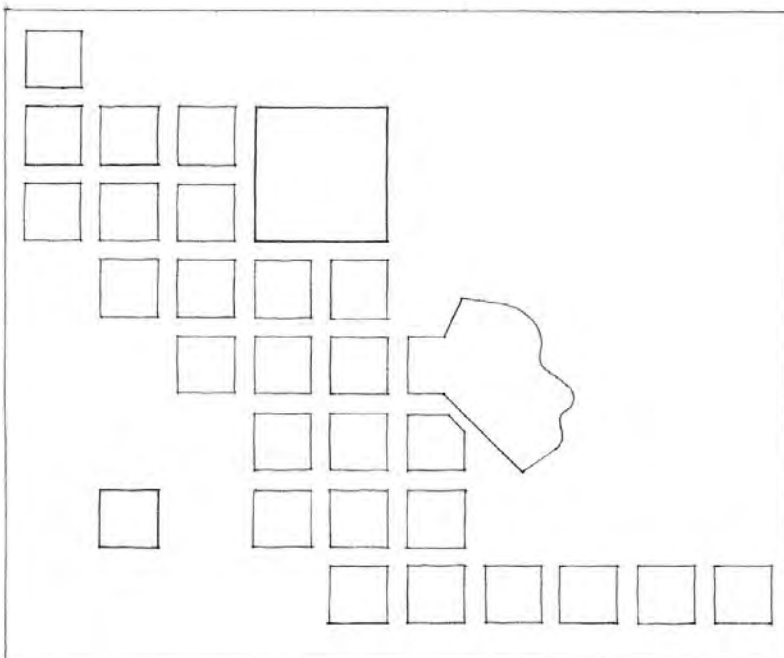
Hierarchy by Size

A form or space may dominate an architectural composition by being significantly different in size from all the other elements in the composition. Normally, this dominance is made visible by the sheer size of an element. In some cases, an element can dominate by being significantly smaller than the other elements in the organization, but placed in a well-defined setting.
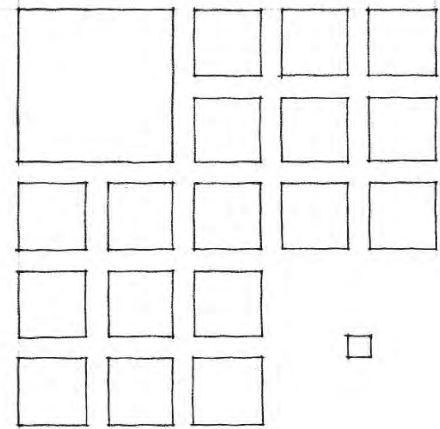
Hierarchy by Shape

A form or space can be made visually dominant and thus important by clearly differentiating its shape from that of the other elements in the composition. A discernible contrast in shape is critical, whether the differentiation is based on a change in geometry or regularity. Of course, it is also important that the shape selected for the hierarchically significant element be compatible with its functional use.
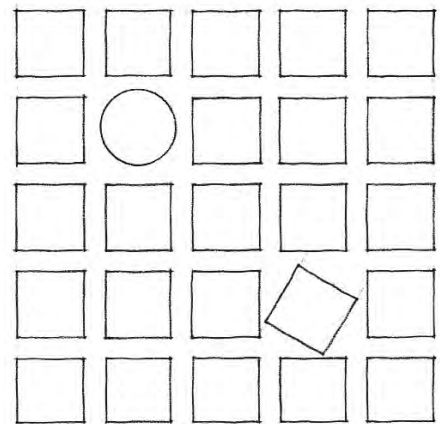
Hierarchy by Placement

A form or space may be strategically placed to call attention to itself as being the most important element in a composition. Hierarchically important locations for a form or space include:

• the termination of a linear sequence or axial organization
• the centerpiece of a symmetrical organization
• the focus of a centralized or radial organization
• being offset above, below, or in the foreground of a composition
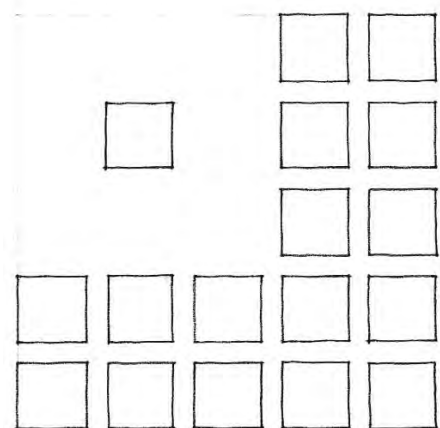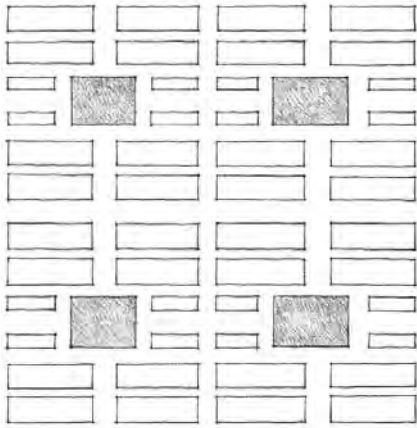
Plan for Savannah, Georgia, 1733, James Oglethorpe
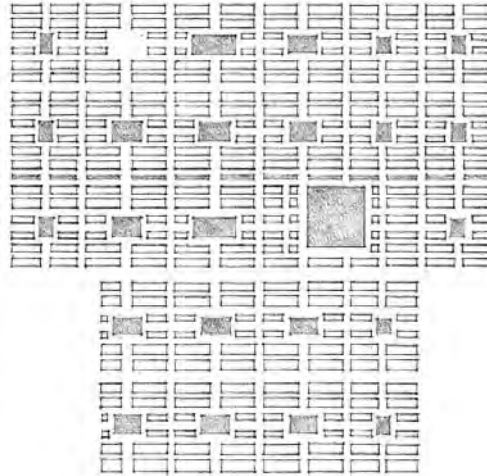
Savannah Plan, after 1856
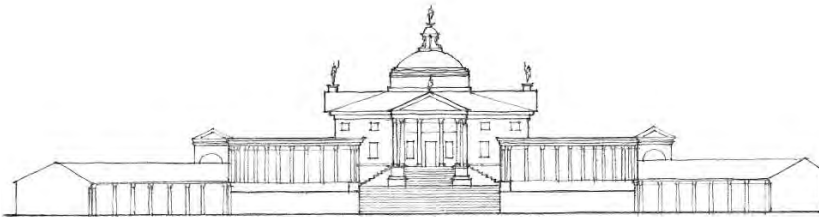
Villa Trissino at Meledo, From *The Four Books on Architecture*, Andrea Palladio
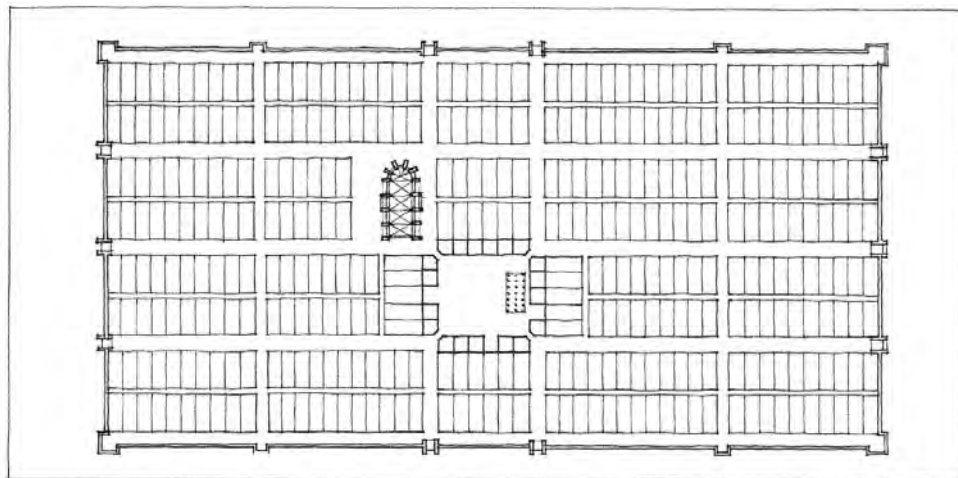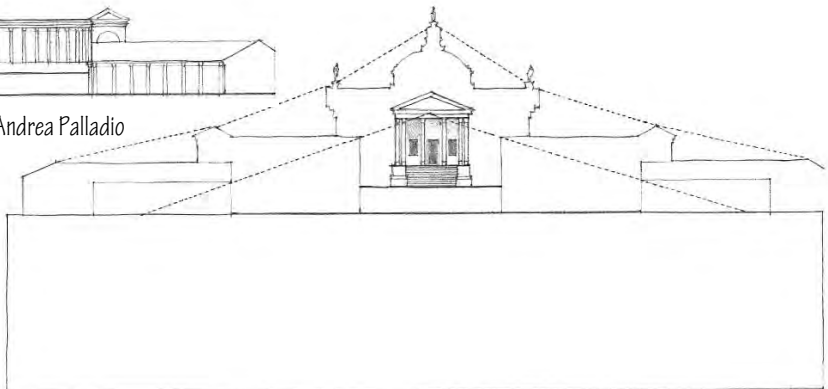
Plan of Montfazier, France, a Medieval town founded in 1284
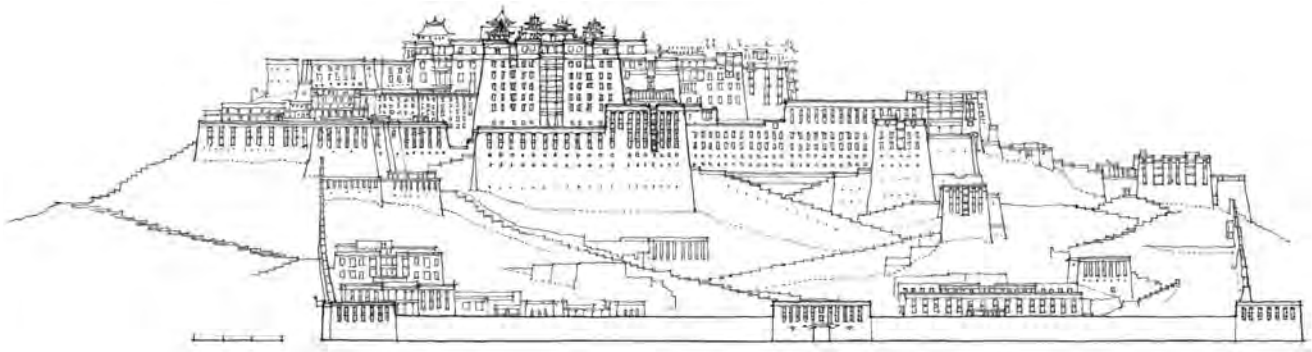
Potala Palace, Lhasa, Tibet (China), 17th century
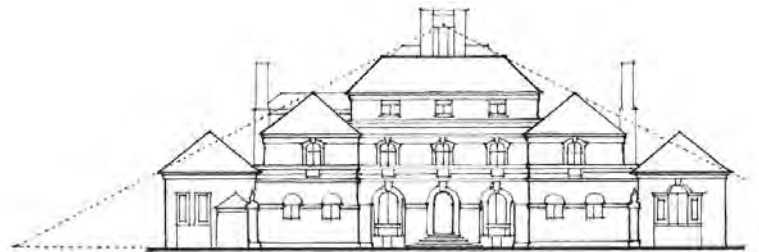
Heathcote (Hemingway House), Ilkley, Yorkshire, England, 1906, Sir Edwin Lutyens

View of Florence illustrating the dominance of the cathedral over the urban landscape
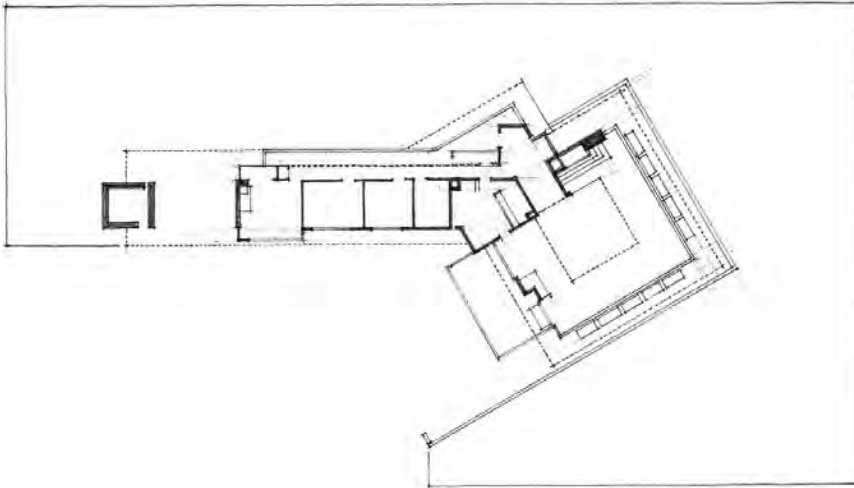
Lowell Walter House, Quasqueton, Iowa, 1949, Frank Lloyd Wright

Institute of Technology, Otaniemi, Finland, 1955–64, Alvar Aalto
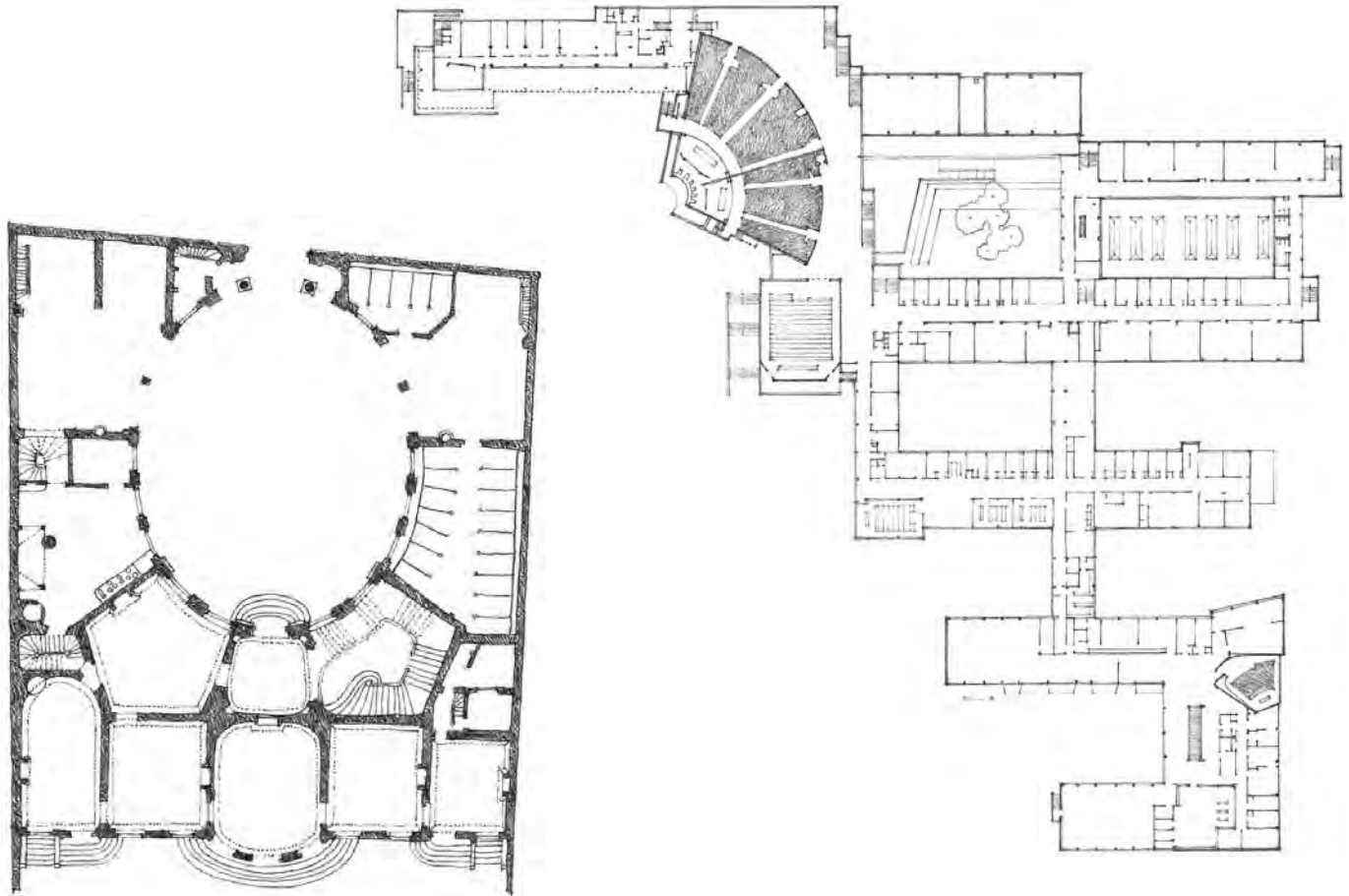
Hôtel Amelot, Paris, 1710–13, Germain Boffrand
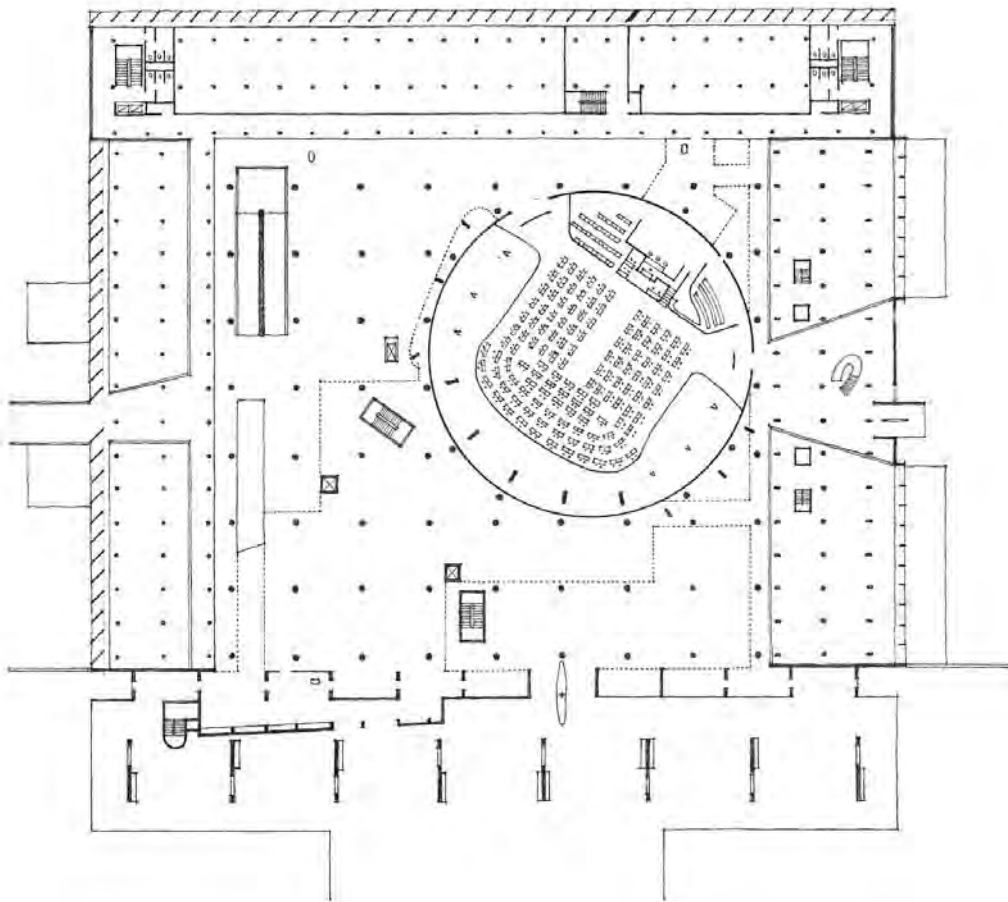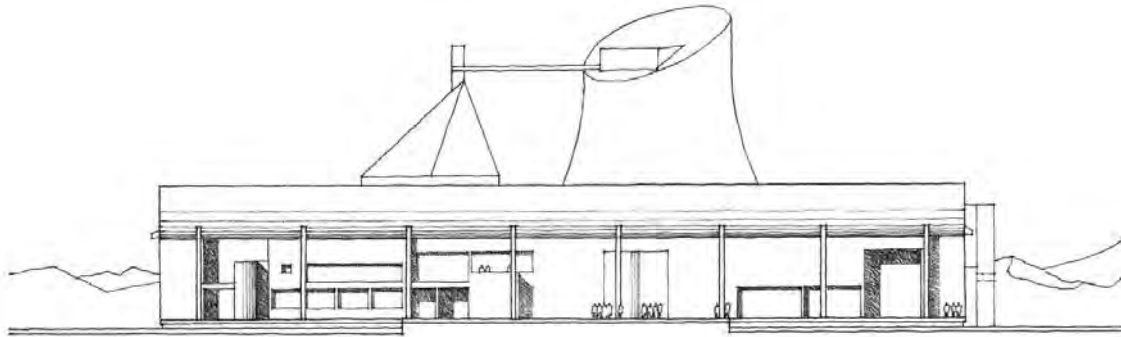
Legislative Assembly Building, Chandigarh, Capitol Complex of Punjab, India, 1956–59, Le Corbusier
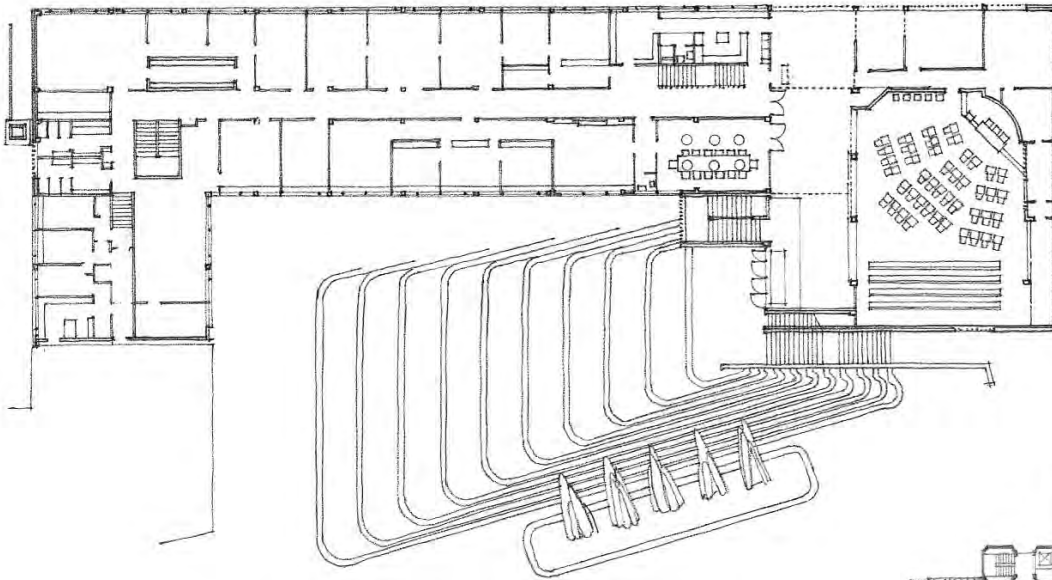
Town Hall, **Seinäjoki**, 1961-65, Alvar Aalto
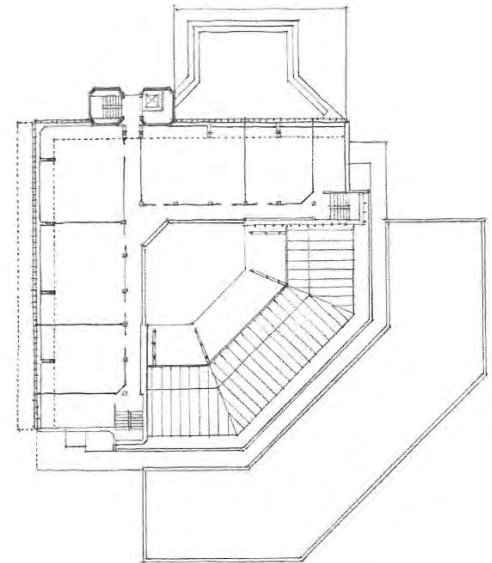
History Faculty Building, **Cambridge University**, England, 1964–67, James Stirling
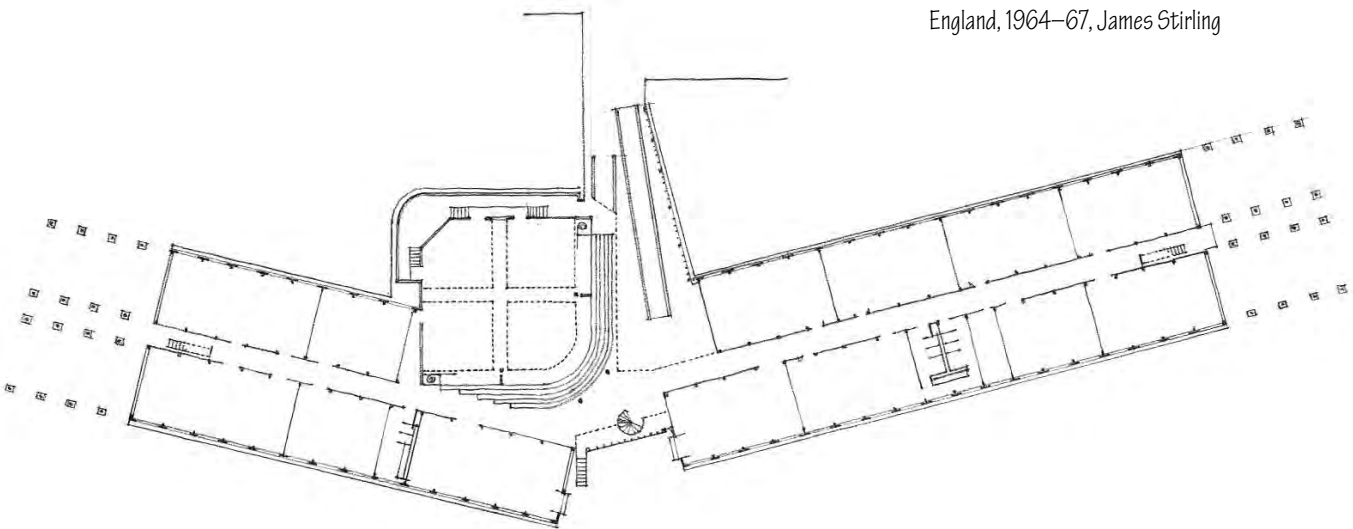
Olivetti Training School, Haslemere, England, 1969–72, James Stirling
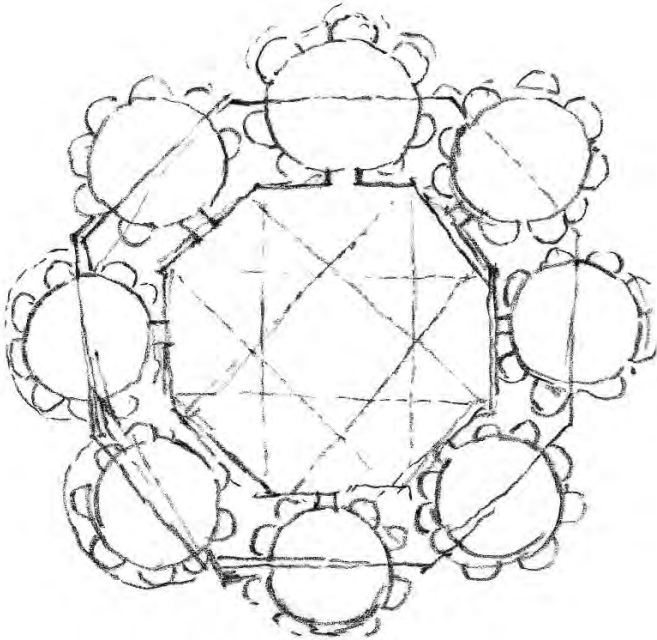
Plan of an Ideal Church, c. 1490, Leonardo da Vinci
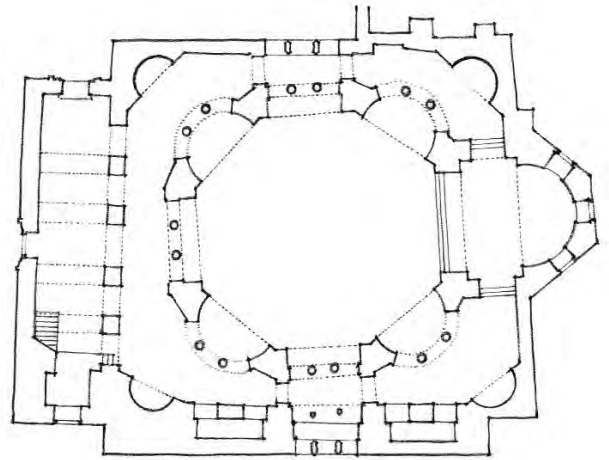
S.S. Sergius and Bacchus, Constantinople (Istanbul), A.D. 525–30
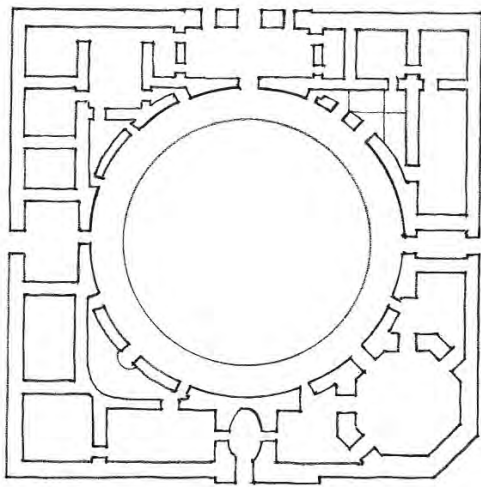
Palace of Charles V, Granada, 1527–68, Pedro Machuca
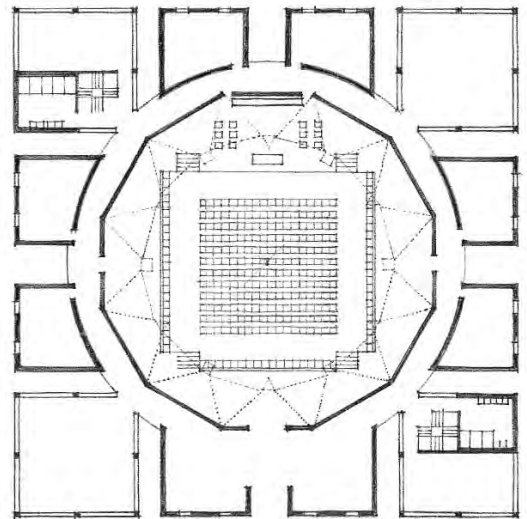
First Unitarian Church, First Design, Rochester, New York, 1959, Louis Kahn

Excerpt from **Gavotte I, Sixth Cello Suite,** by Johann Sebastian Bach (1685–1750). Transcribed for classical guitar by Jerry Snyder.
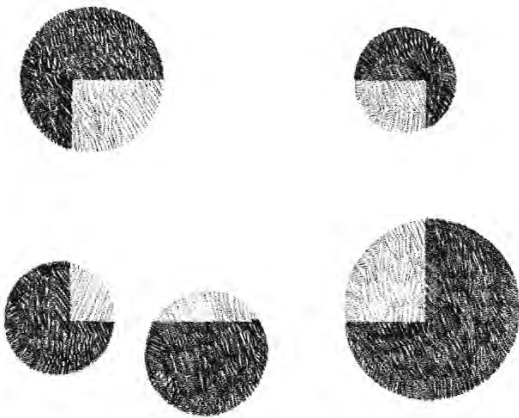
A datum refers to a line, plane, or volume of reference to which other elements in a composition can relate. It organizes a random pattern of elements through its regularity, continuity, and constant presence. For example, the lines of a musical staff serve as a datum in providing the visual basis for reading notes and the relative pitches of their tones. The regularity of their spacing and their continuity organizes, clarifies, and accentuates the differences between the series of notes in a musical composition.

A preceding section illustrated the ability of an axis to organize a series of elements along its length. In effect, the axis was serving as a datum. A datum, however, need not be a straight line. It can also be planar or volumetric in form.

To be an effective ordering device, a linear datum must have sufficient visual continuity to cut through or bypass all of the elements being organized. If planar or volumetric in form, a datum must have sufficient size, closure, and regularity to be seen as a figure that can embrace or gather together the elements being organized within its field.

Given a random organization of dissimilar elements, a datum can organize the elements in the following ways:

Line
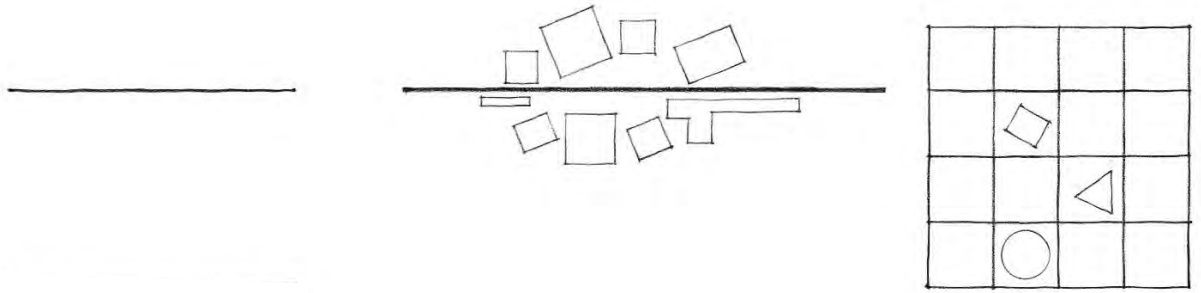
A line can cut through or form a common edge for the pattern, while a grid of lines can form a neutral, unifying field for the pattern.

Plane
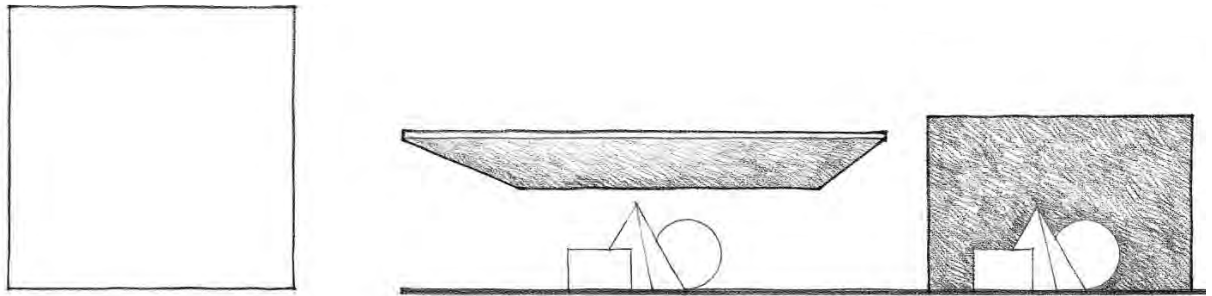
A plane can gather the pattern of elements beneath it or serve as an encompassing background for the elements and frame them in its field.

Volume
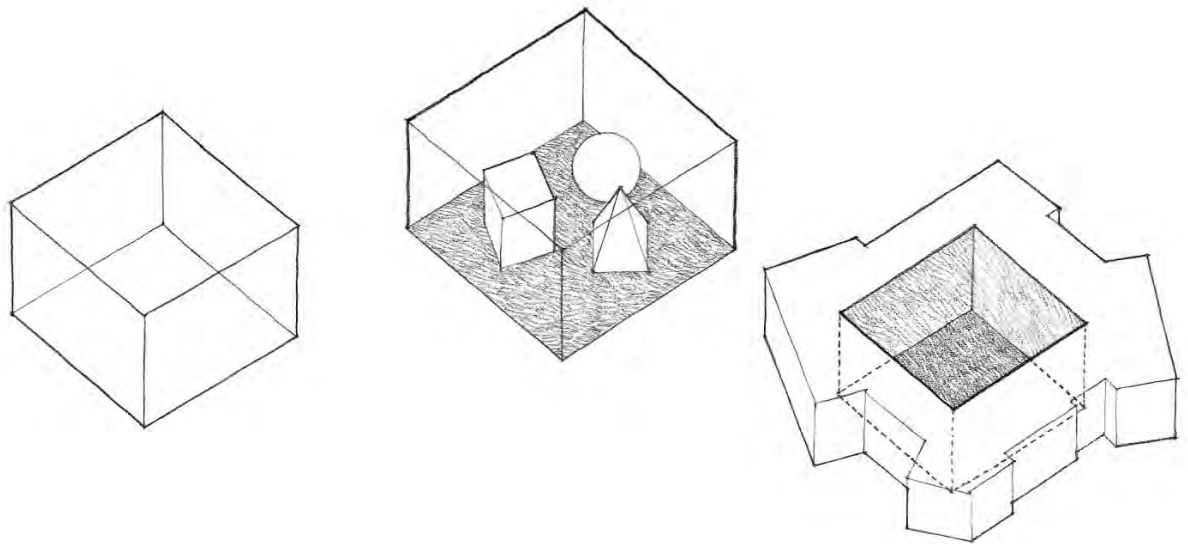
A volume can collect the pattern of elements within its boundaries or organize them along its perimeter.
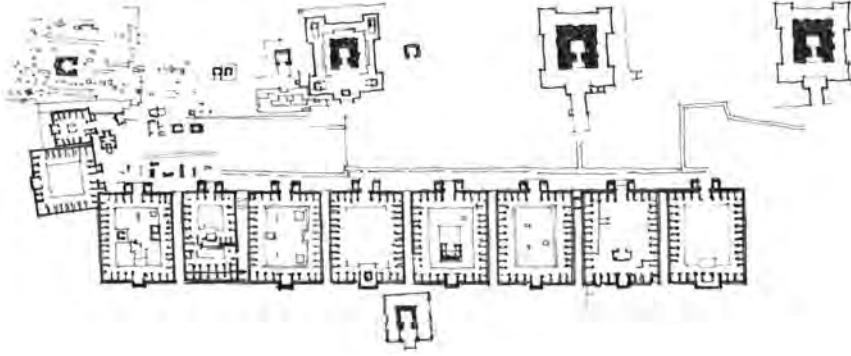
Mahavihara at Nalanda, India, 6th–7th century A.D.

Datum
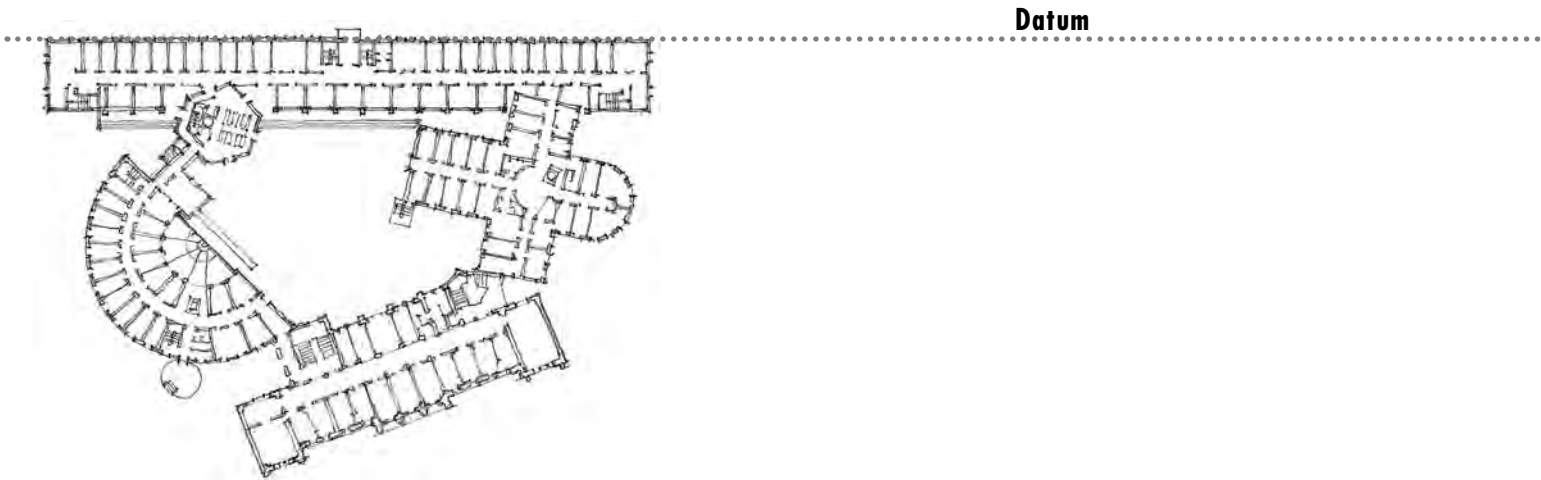
Social Science Research Center, Berlin, Germany, 1981, James Stirling
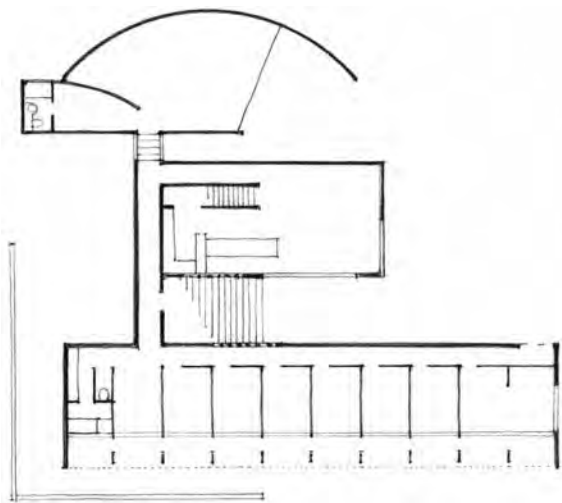
Koshino House, Ashiya, Hyogo Prefecture, Japan, 1979–84, Tadao Ando
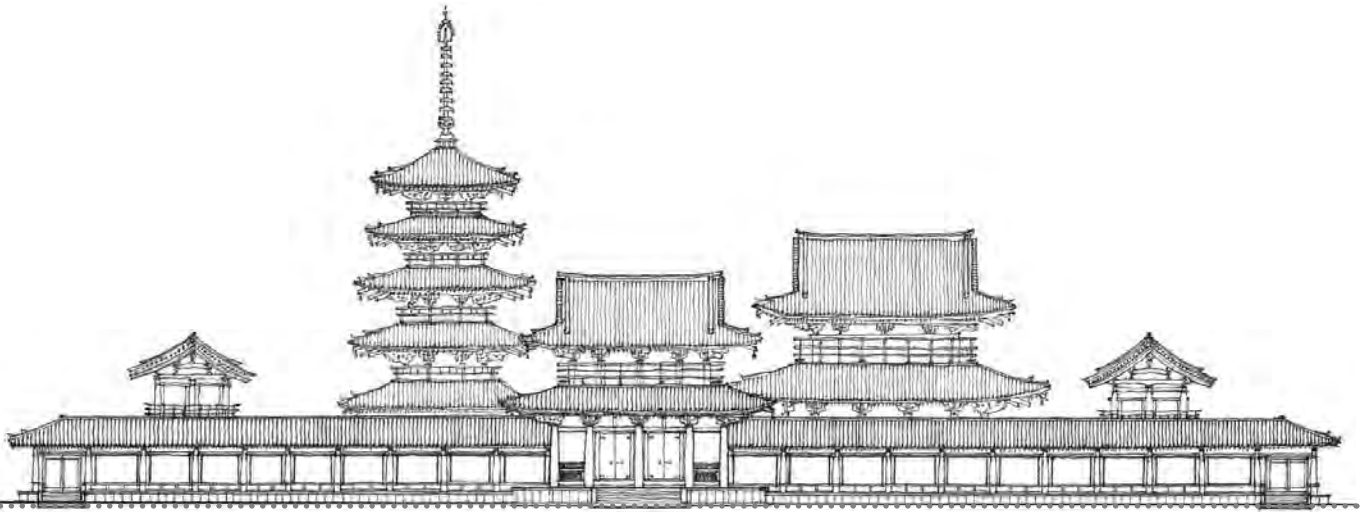
West Precinct, Horyu-Ji Temple, Nara Prefecture, Japan, A.D. 607–746

Arcades unify the facades of houses that front the town square of Telo, Czechoslovakia.
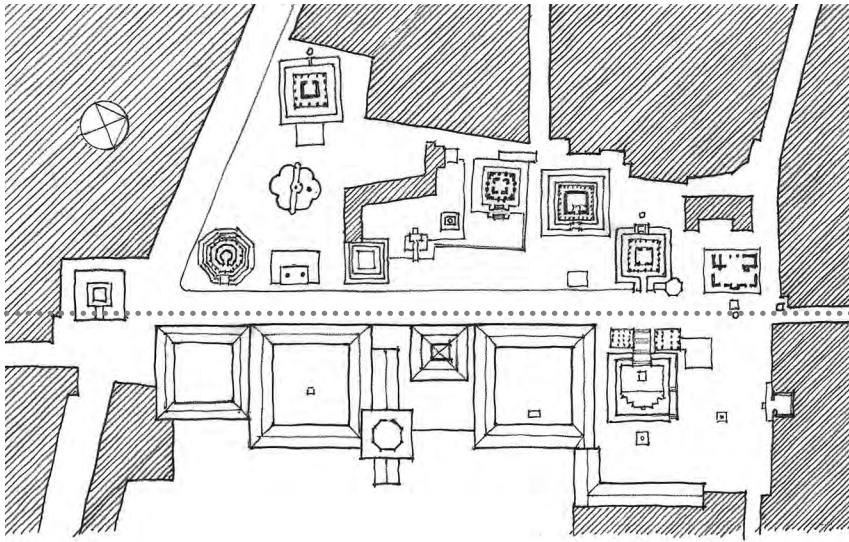
Durbar Square, Patan, Nepal, renovated 17th century
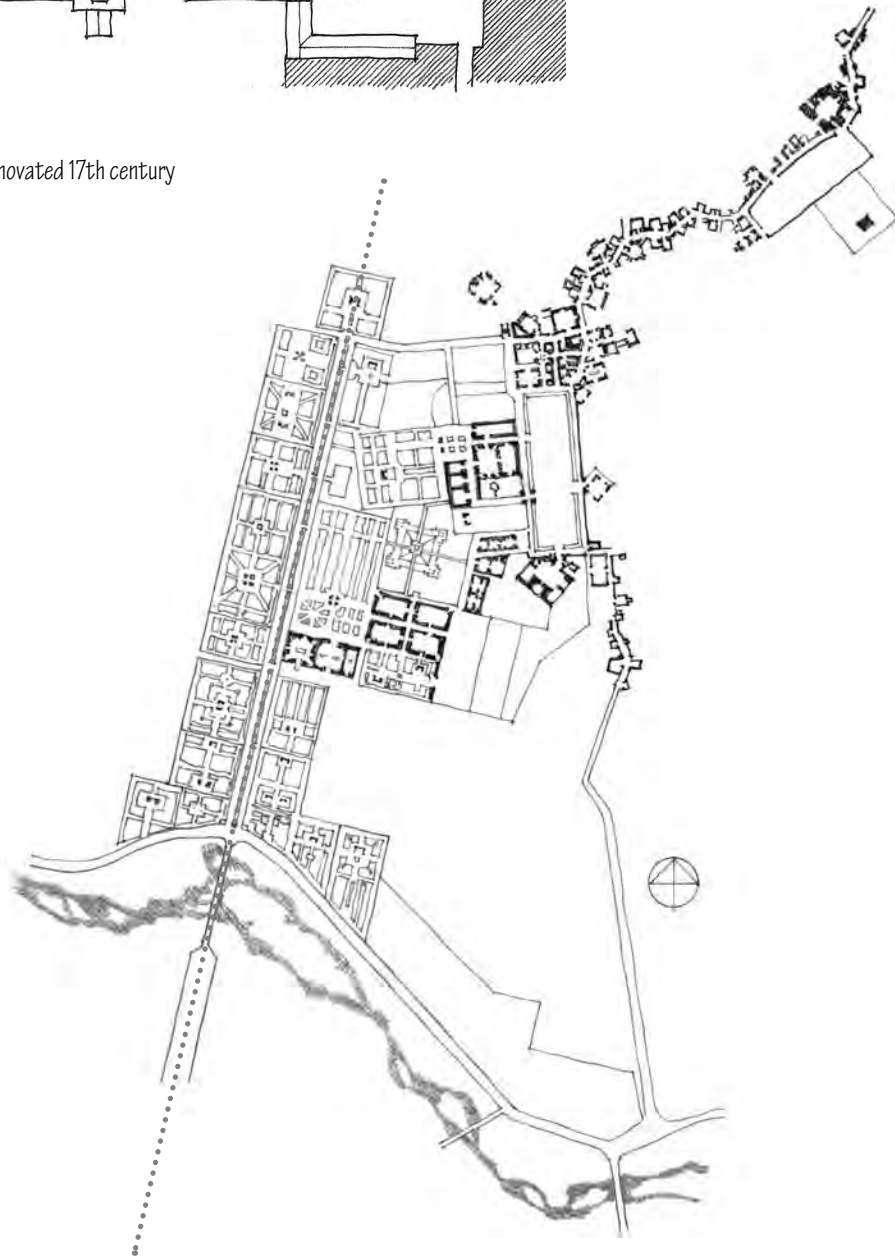
Plan of Safavid **Isfahan**, Iran
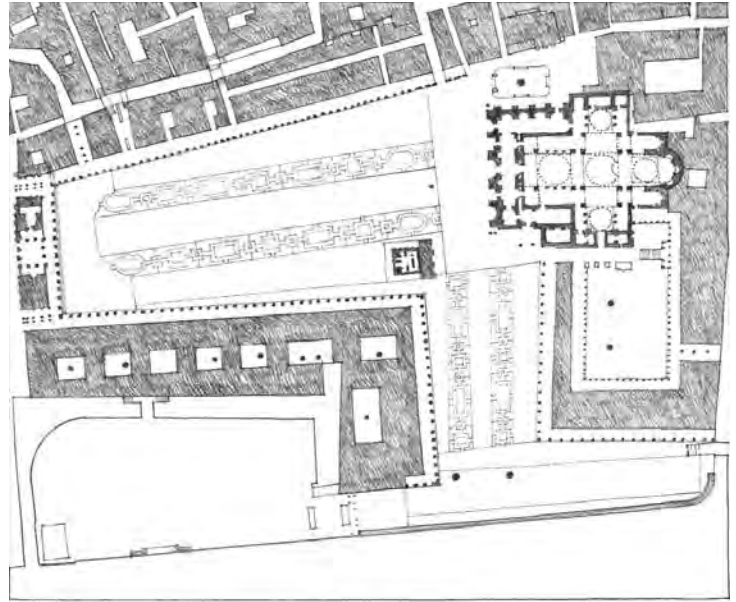
Piazza San Marco, *Venice*
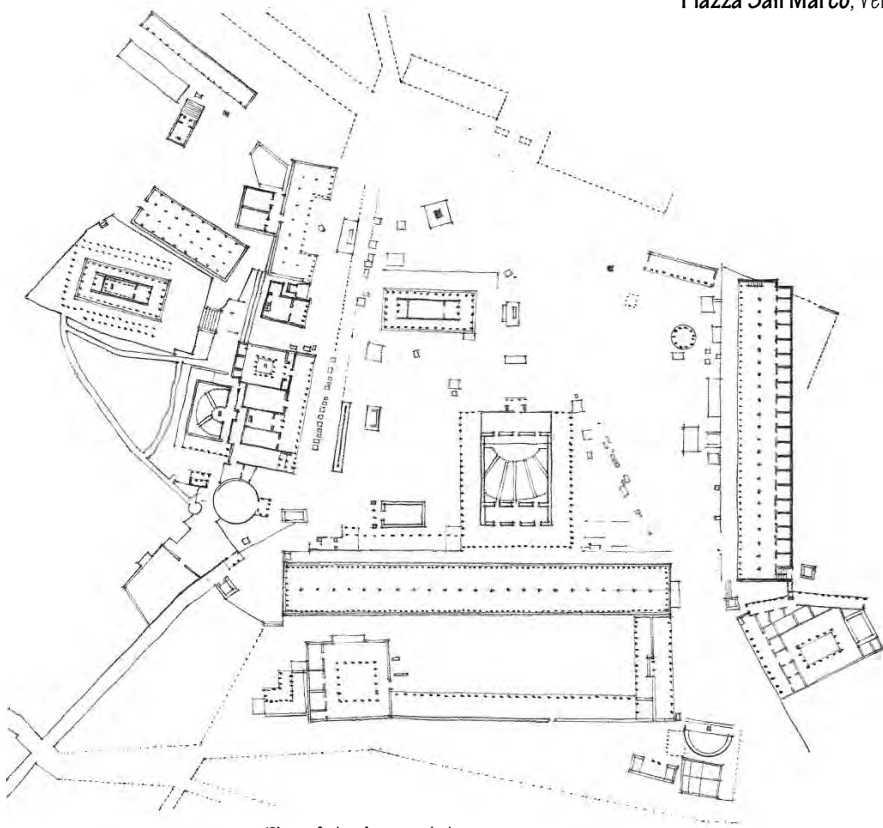
Plan of the **Agora**, Athens
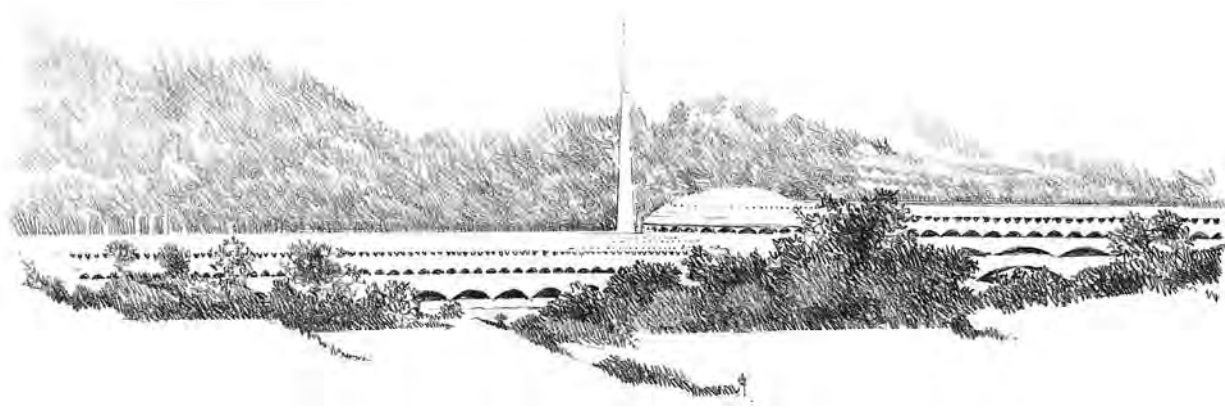
Marin County Civic Center, San Rafael, California, 1957, Frank Lloyd Wright
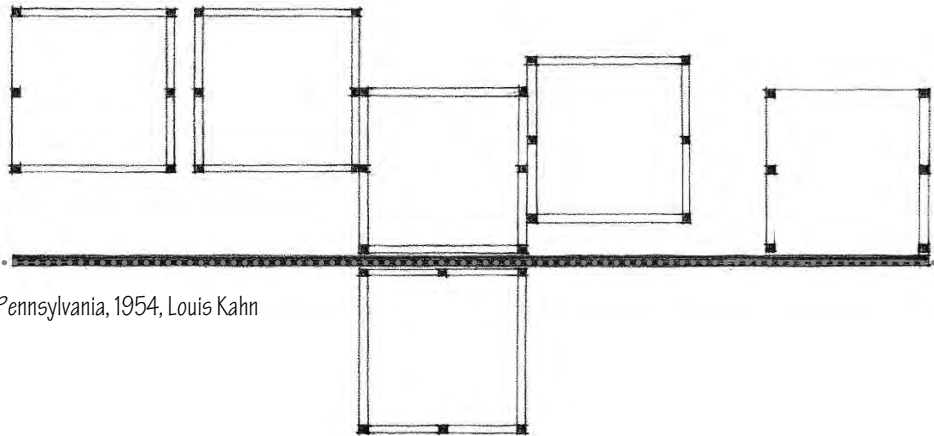
DeVore House (Project), Montgomery County, Pennsylvania, 1954, Louis Kahn
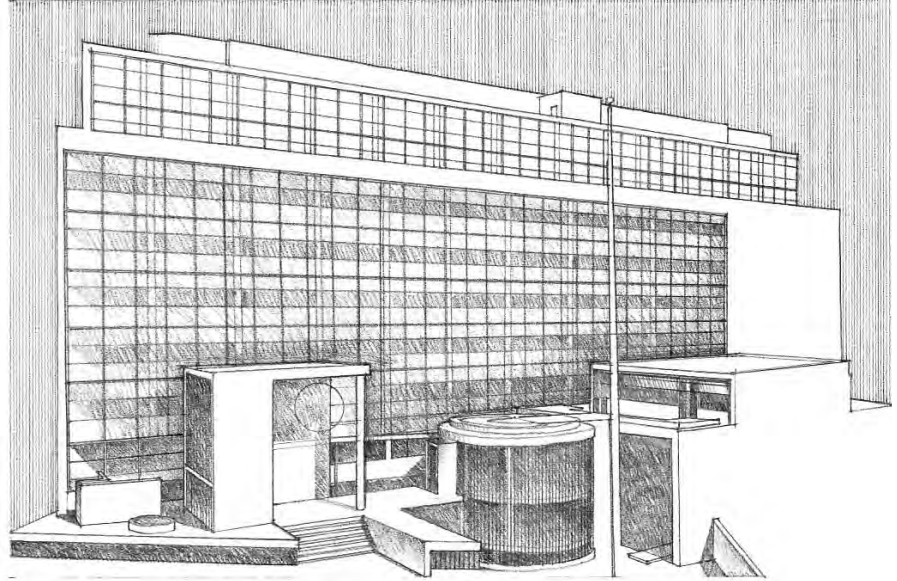
Salvation Army Hostel, Paris, 1928–33, Le Corbusier

Cultural Center (Competition Entry), Leverkusen, Germany, 1962, Alvar Aalto
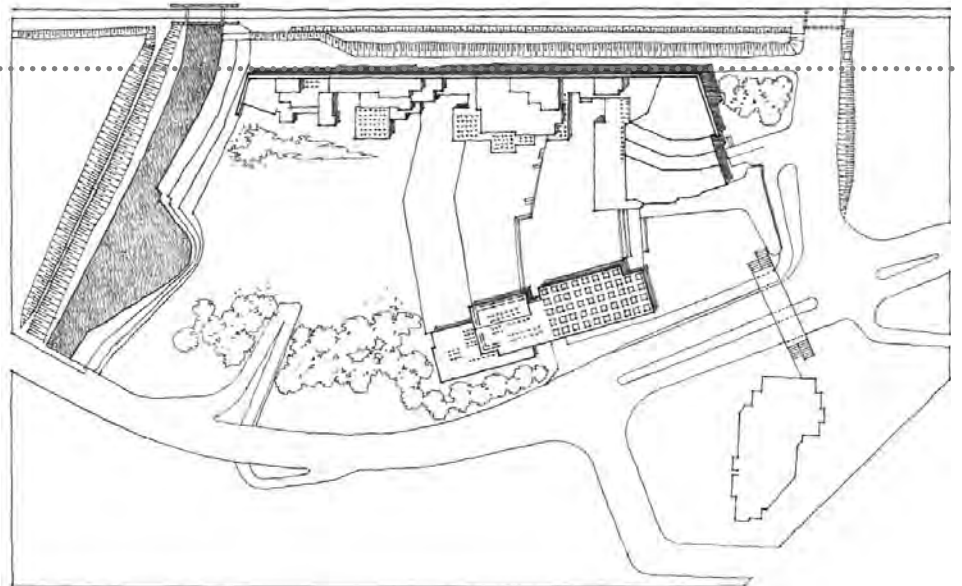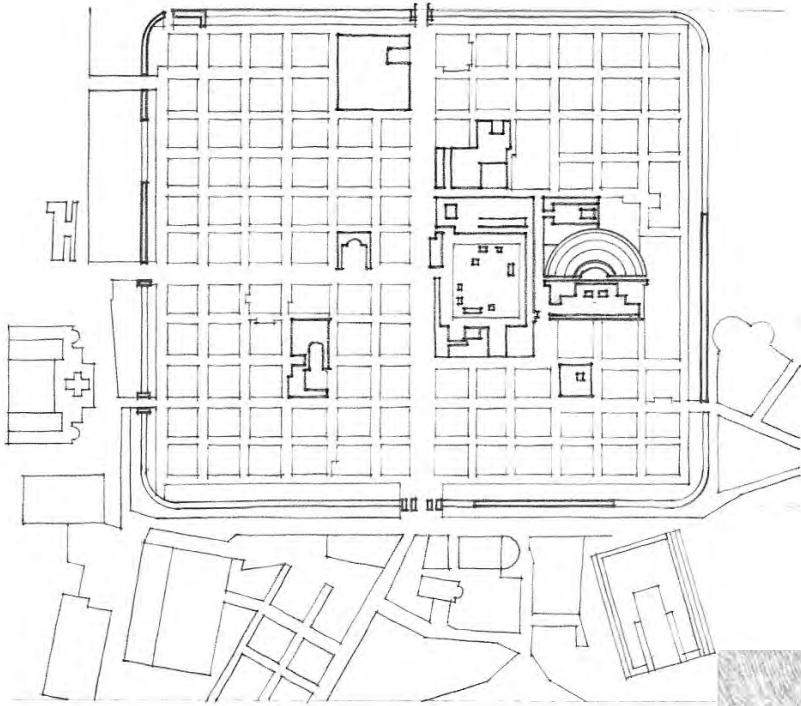
Town Plan of Timgad, a Roman colony in North Africa founded 100 B.C.
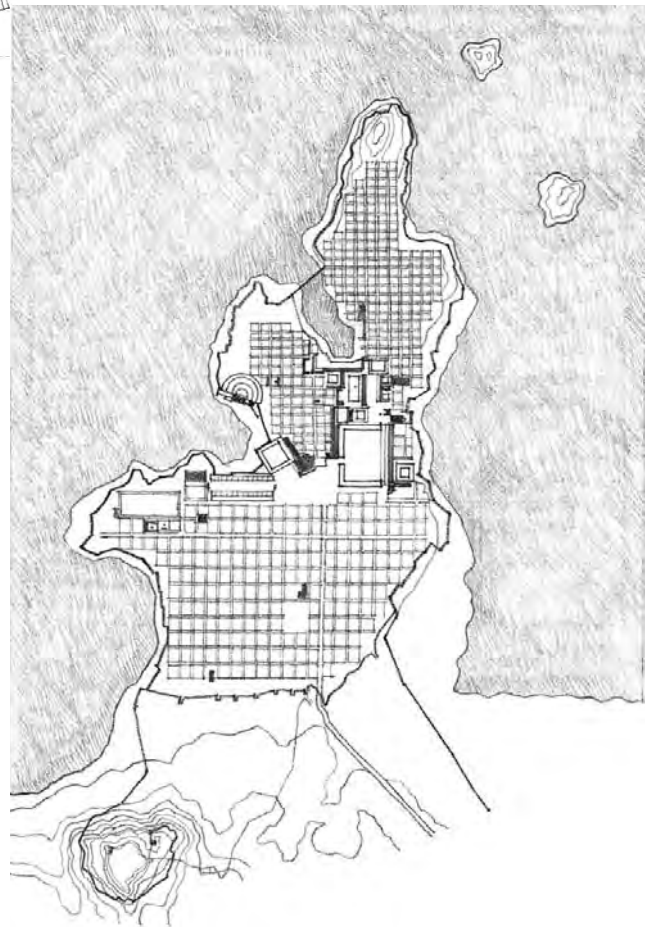
Plan of Miletus, 5th century B.C.
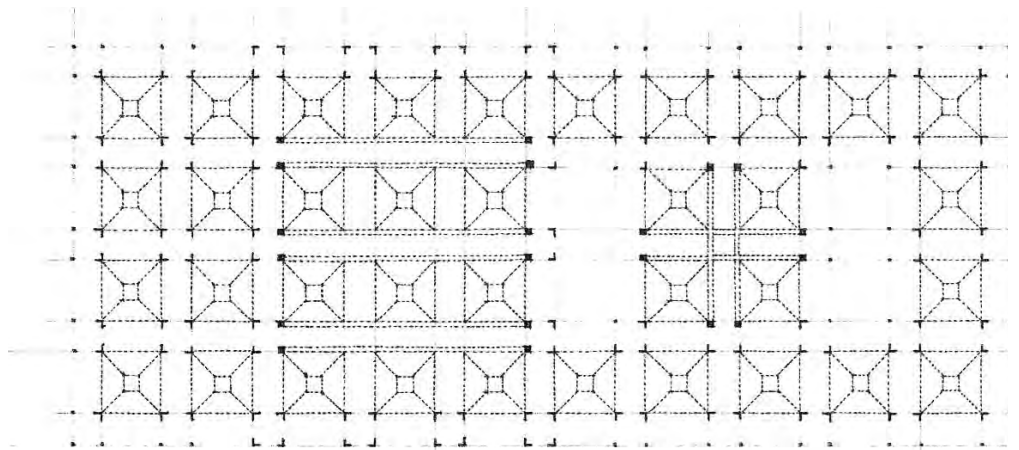
Structural Grid of Main Building, **Jewish Community Center,** Trenton, New Jersey, 1954–59, Louis Kahn
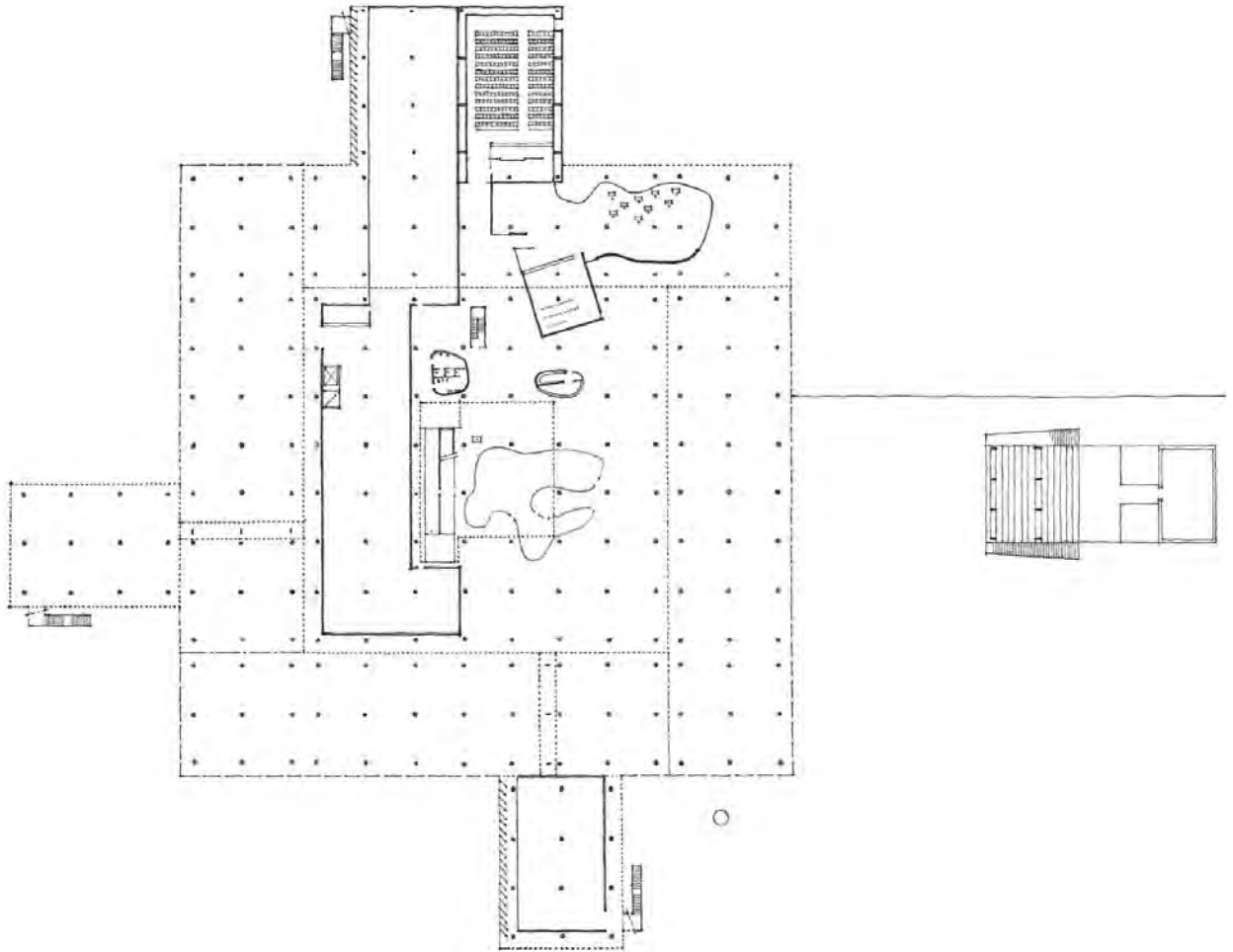
Museum, **Ahmedabad**, India, 1954–57, Le Corbusier
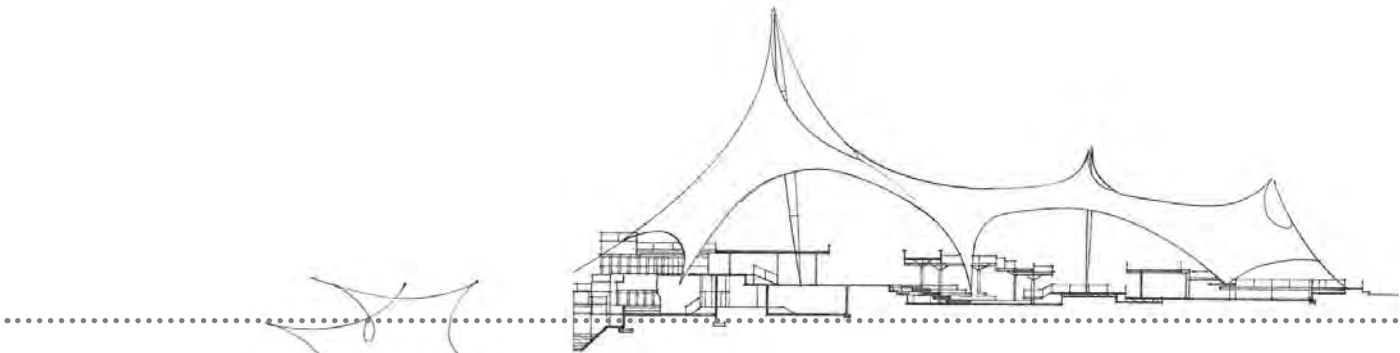
Section
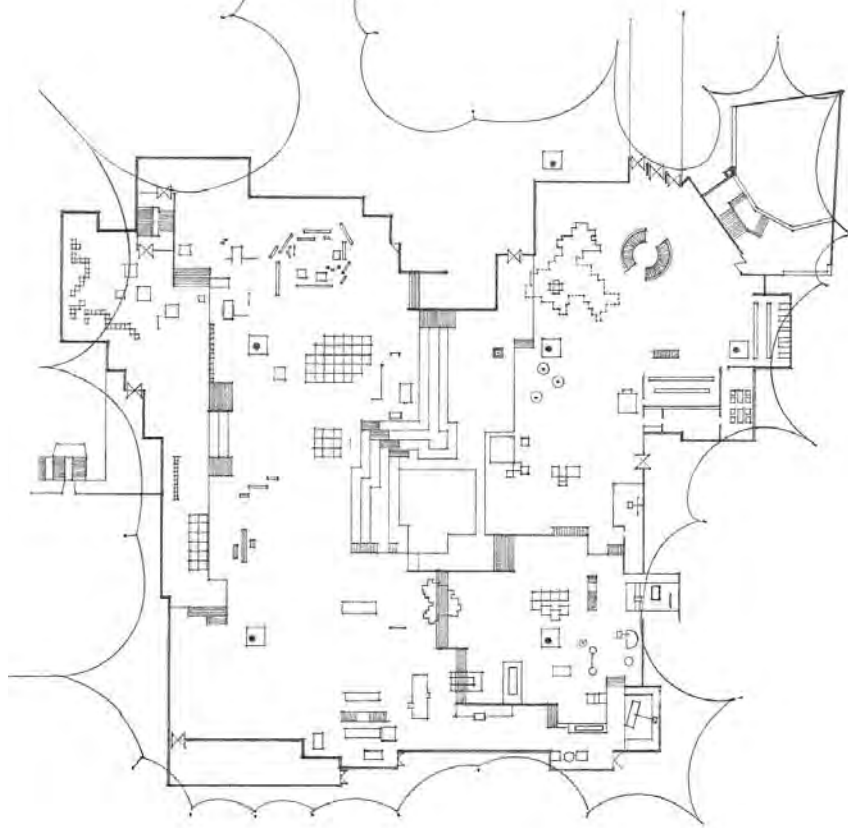
German Pavilion, **Montreal World Exposition**, 1966–67, Rolf Gutbrod and Frei Otto

Ground Floor Plan
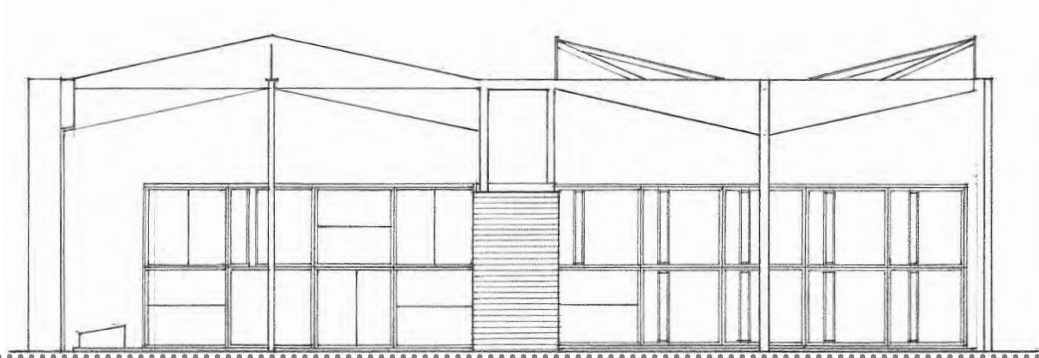
North Elevation
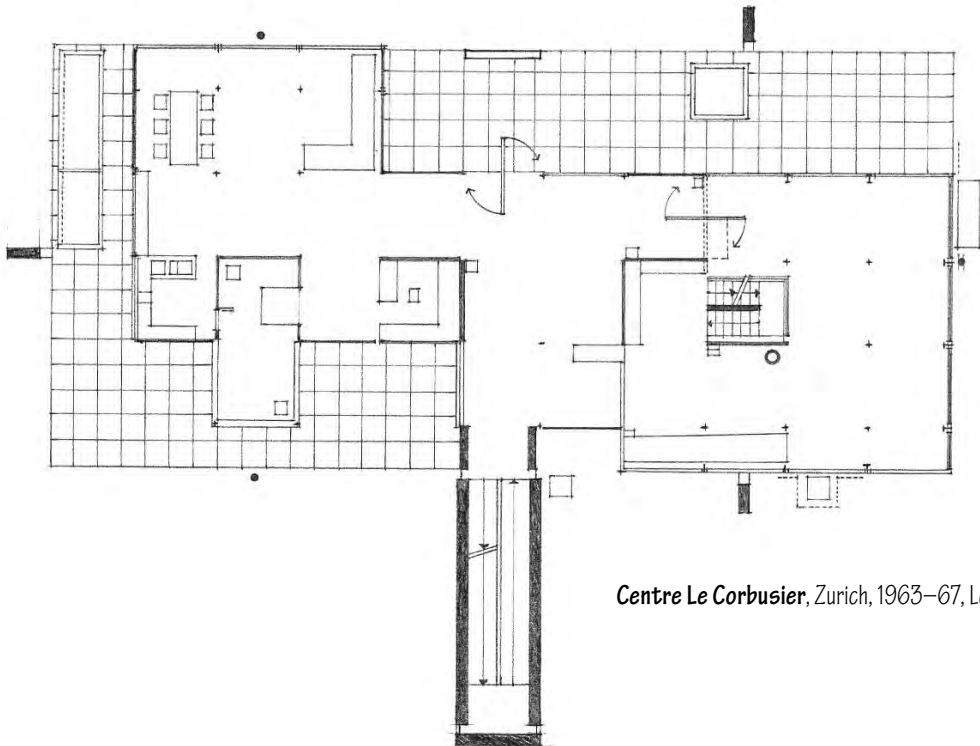
Centre Le Corbusier, Zurich, 1963–67, Le Corbusier
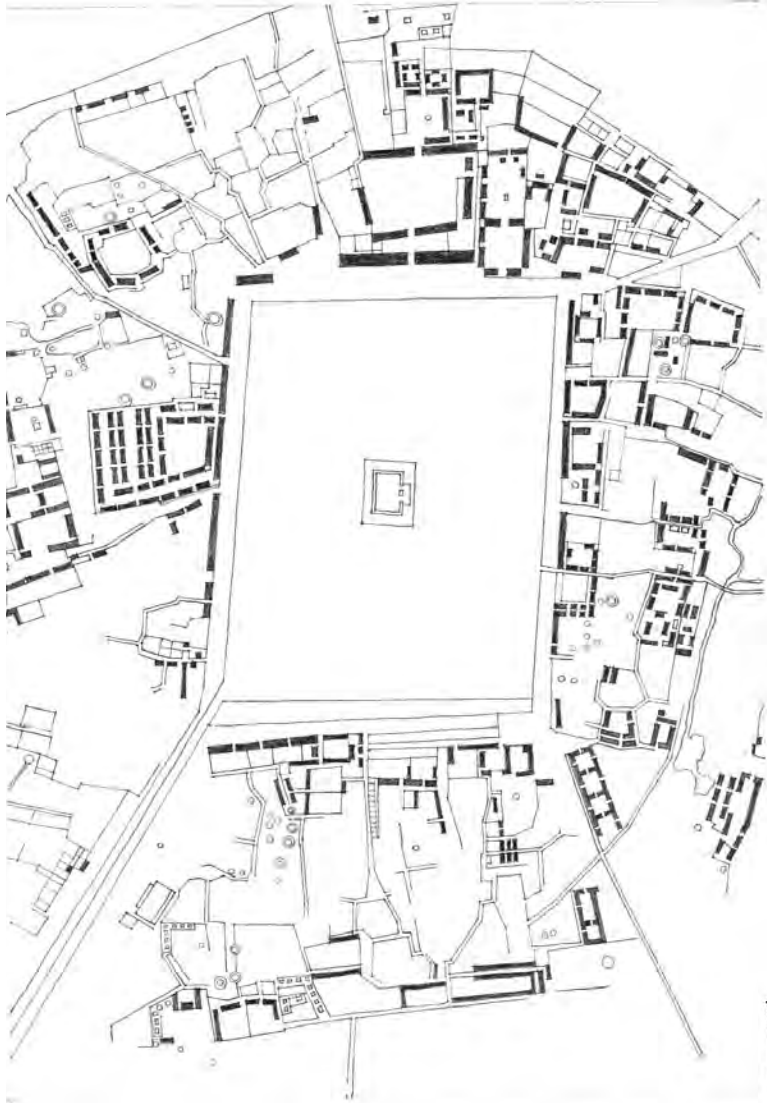
Plan of Huánoco, an Inca Town in central Peru
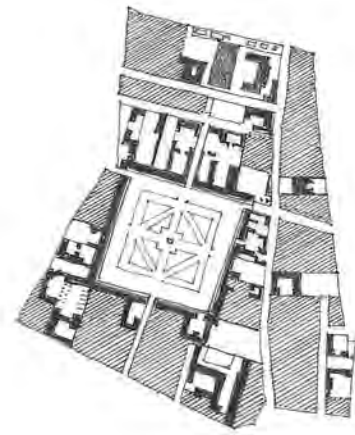
Place Royale, Paris, France, 18th century
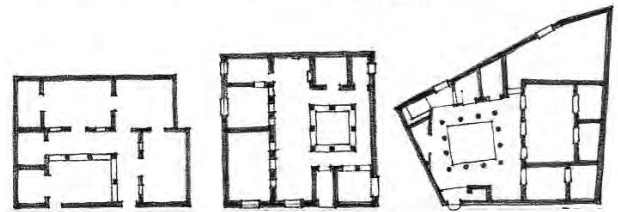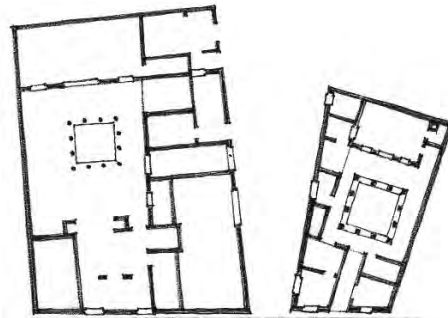
Plan of Peristyle Courtyard Houses on Delos, a Greek island in the Aegean
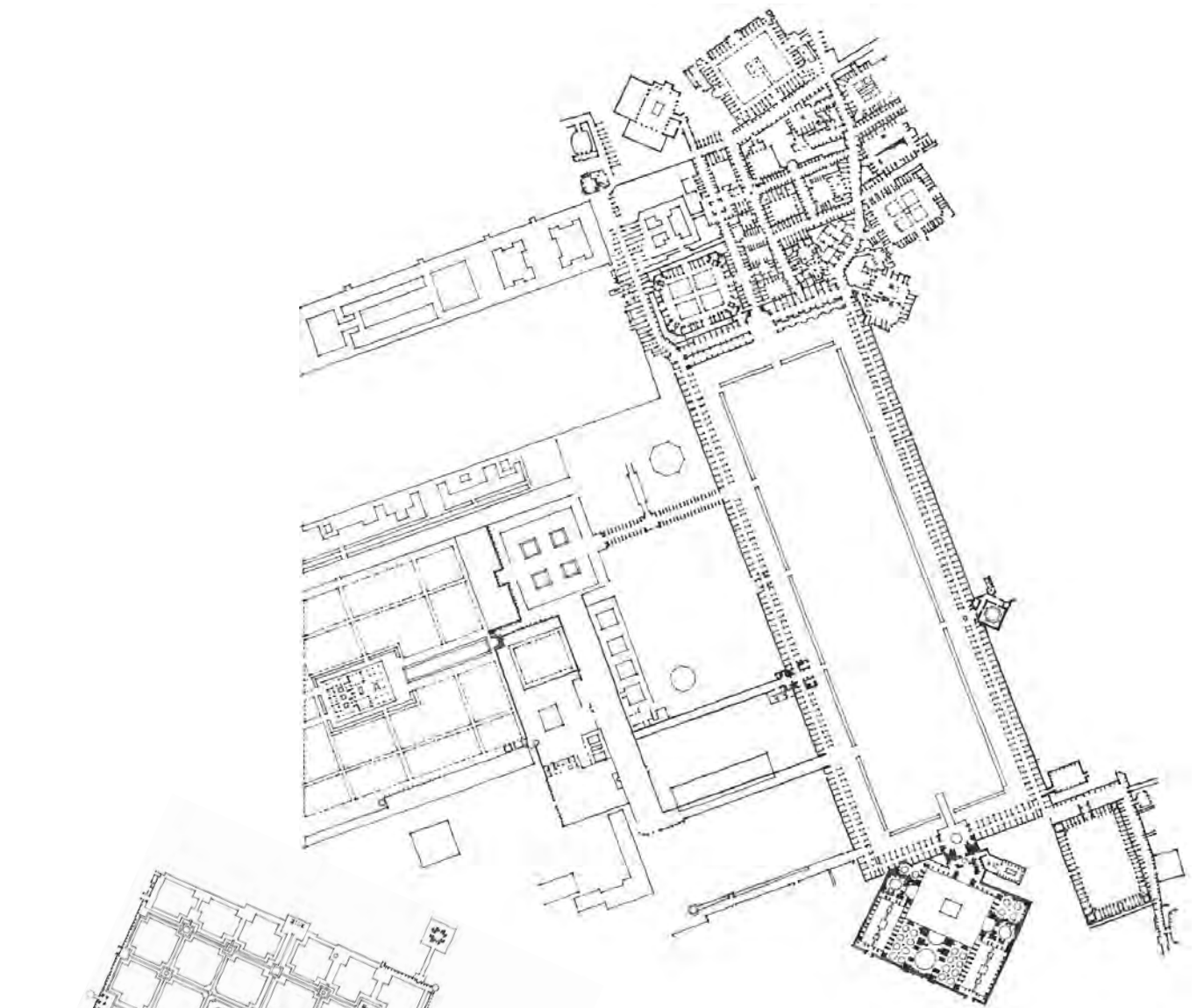
Plan of Civic Center, Isfahan, Capital of Persia, 1628
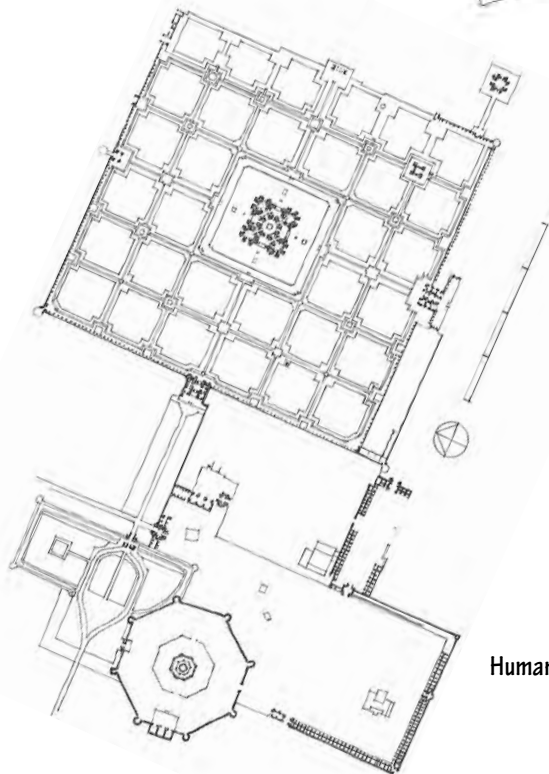
Humanyun's Tomb, Delhi, 1570, Mirak Mirza Ghiyas

Site plan of **Shwezigon Pagoda**, Pagan, 12th century
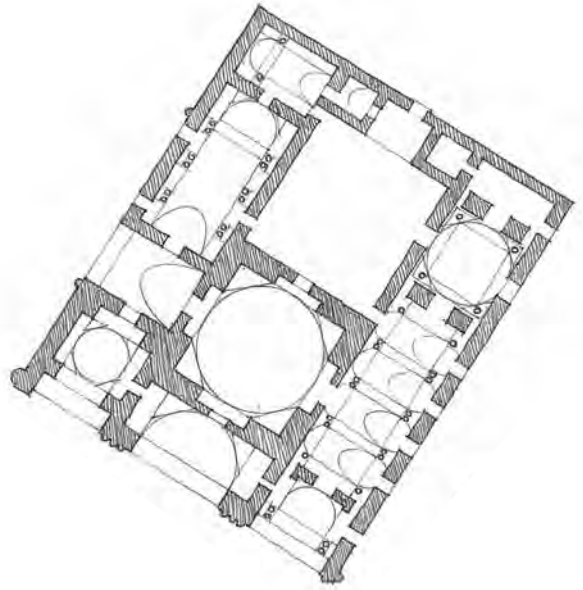
Fire Temple at Sarvistan, Iran, 5th–8th century
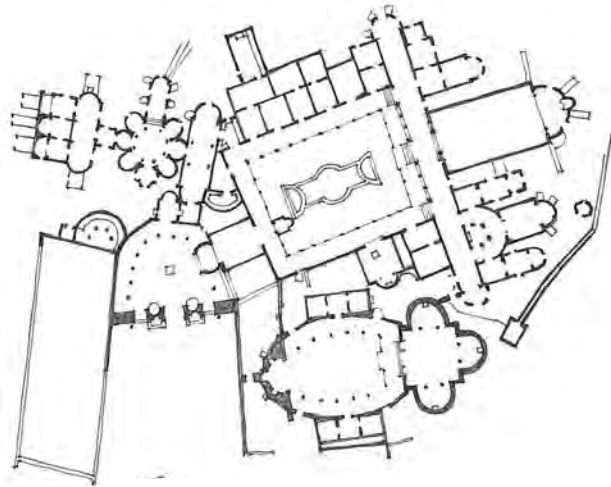
Piazza Armerina, Sicily, Italy, early 4th century
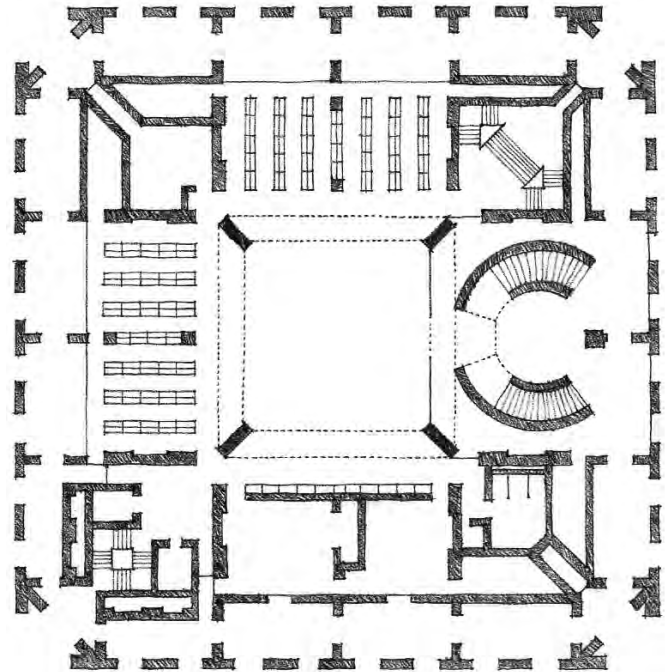
Library, **Philip Exeter Academy**, Exeter, New Hampshire, 1967–72, Louis Kahn
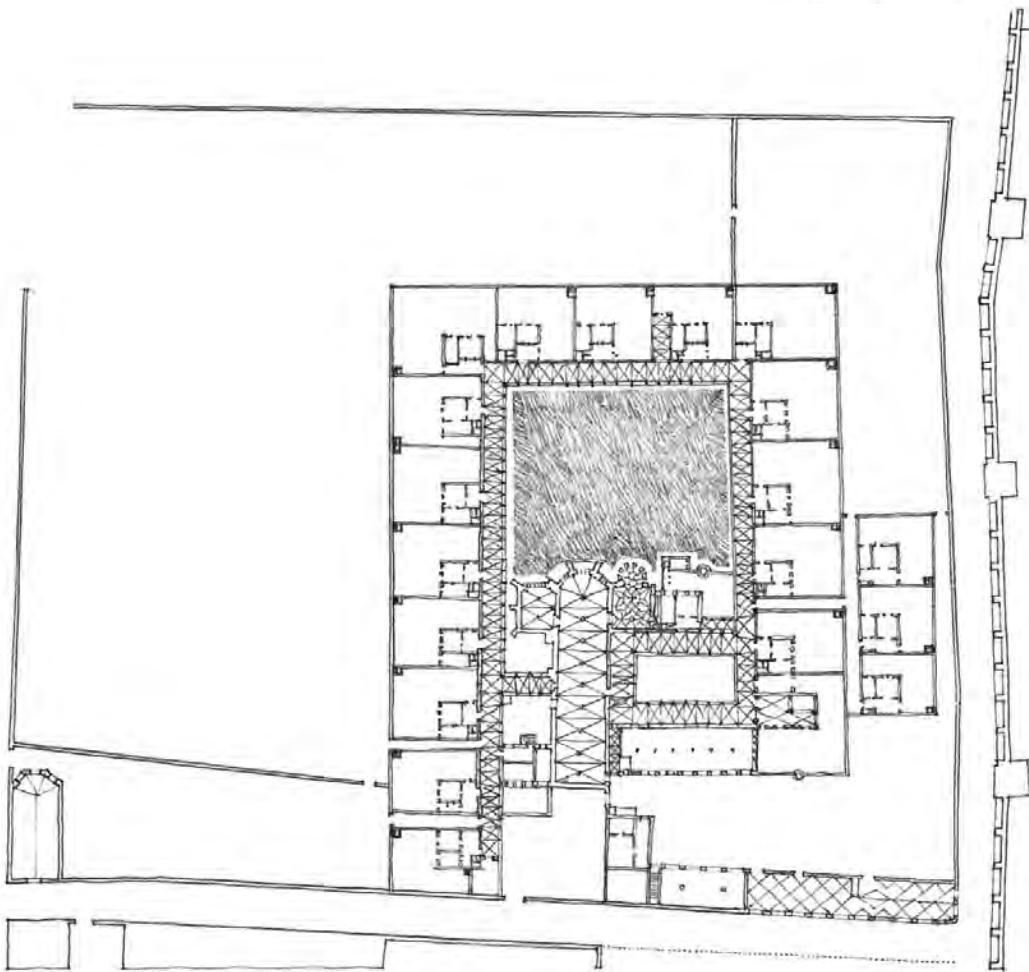
Nuremberg Charterhouse, 1383
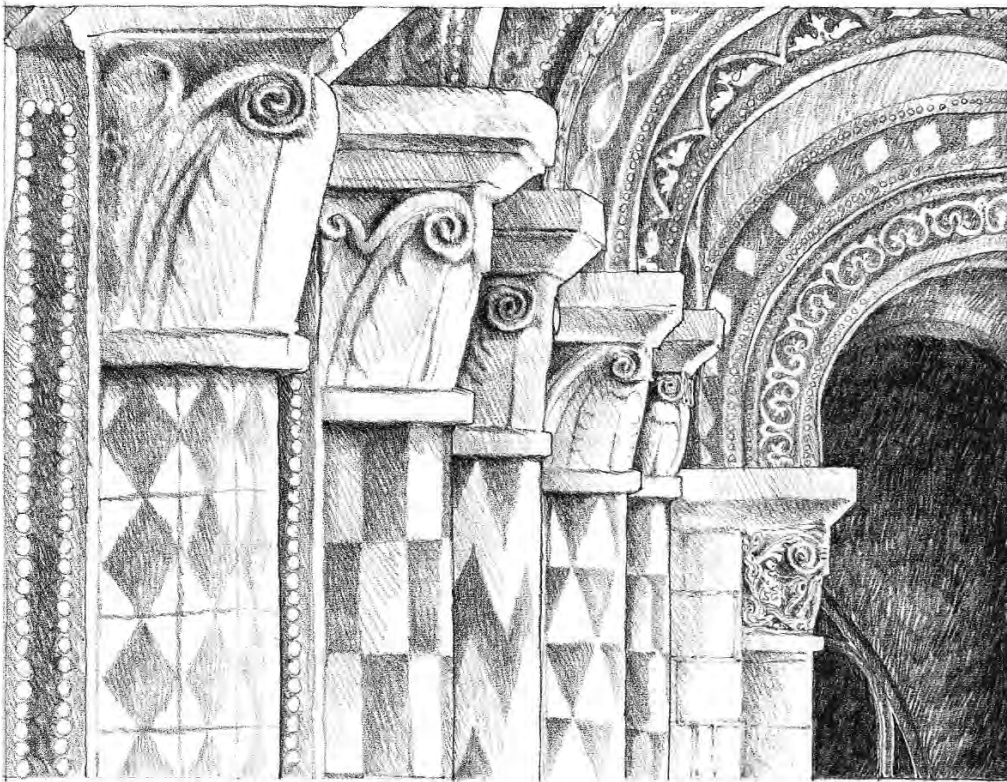
Column Details, **Notre Dame la Grande**, Poitiers, France, 1130–45

Rhythm refers to any movement characterized by a patterned recurrence of elements or motifs at regular or irregular intervals. The movement may be of our eyes as we follow recurring elements in a composition, or of our bodies as we advance through a sequence of spaces. In either case, rhythm incorporates the fundamental notion of repetition as a device to organize forms and spaces in architecture.

Almost all building types incorporate elements that are by their nature repetitive. Beams and columns repeat themselves to form repetitive structural bays and modules of space. Windows and doors repeatedly puncture the surfaces of a building to allow light, air, views, and people to enter the interior. Spaces often recur to accommodate similar or repetitive functional requirements in the building program. This section discusses the patterns of repetition that can be utilized to organize a series of recurring elements, and the resultant visual rhythms these patterns create.
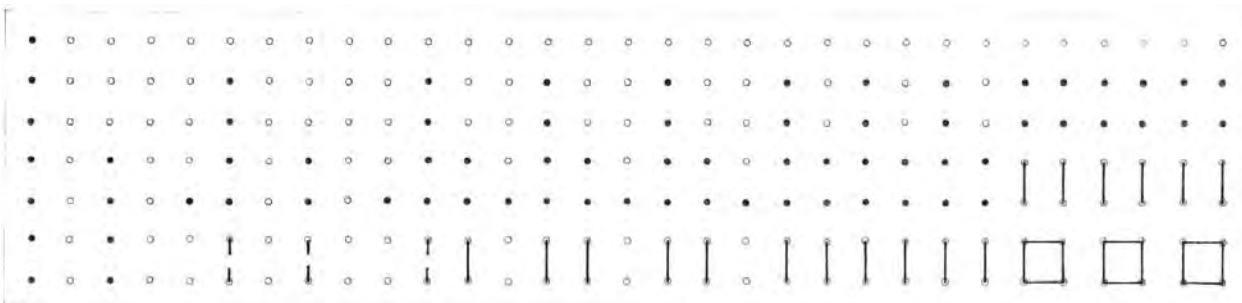
We tend to group elements in a random composition according to:

• their closeness or proximity to one another
• the visual characteristics they share in common

The principle of repetition utilizes both of these concepts of visual perception to order recurring elements in a composition.
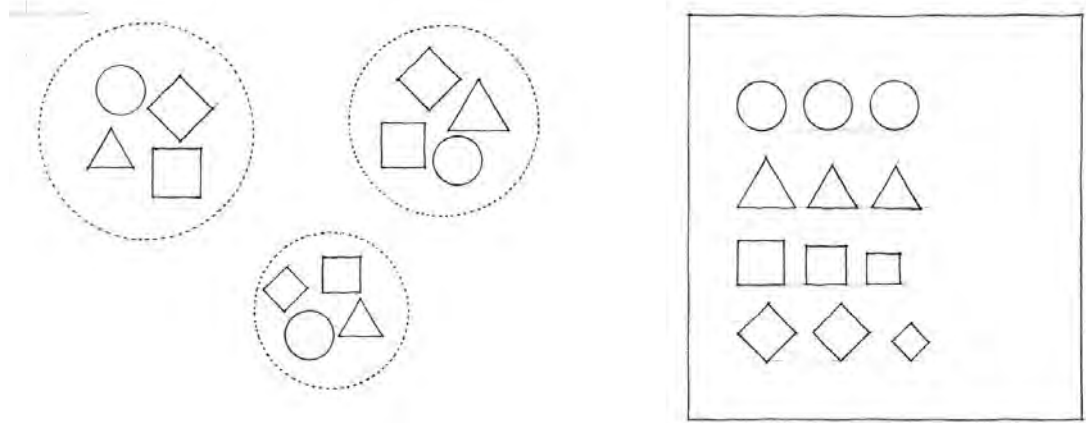
The simplest form of repetition is a linear pattern of redundant elements. Elements need not be perfectly identical, however, to be grouped in a repetitive fashion. They may merely share a common trait or a common denominator, allowing each element to be individually unique, yet belong to the same family.
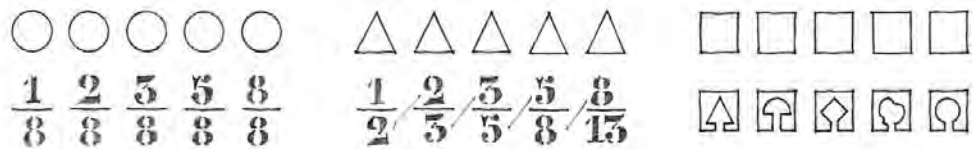
• Size
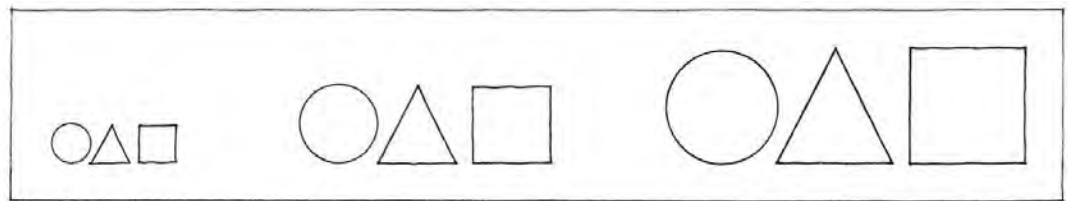
• Shape
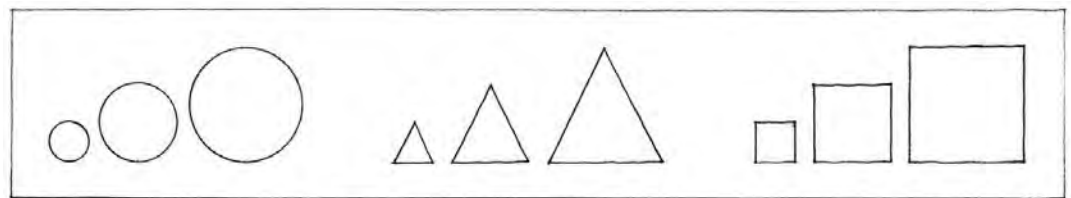
• Detail Characteristics

Distyle in Antis

Prostyle

Amphiprostyle

Peripteral

Dipteral

Pseudodipteral

The Smitheum

Classification of Temples according to the arrangements of the colonnades. From Book III, Chapter II of Vitruvius' *Ten Books on Architecture*.

Structural patterns often incorporate the repetition of vertical supports at regular or harmonious intervals which define modular bays or divisions of space. Within such repetitive patterns, the importance of a space can be emphasized by its size and placement.

Cathedral at Reims, 1211–1290
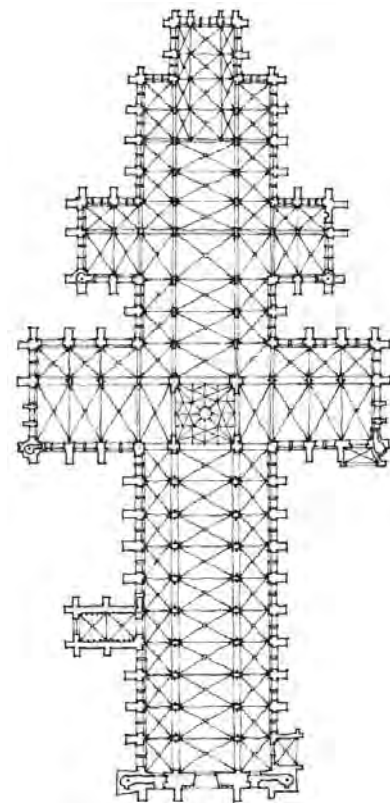
Cathedral at Salisbury, 1220–60
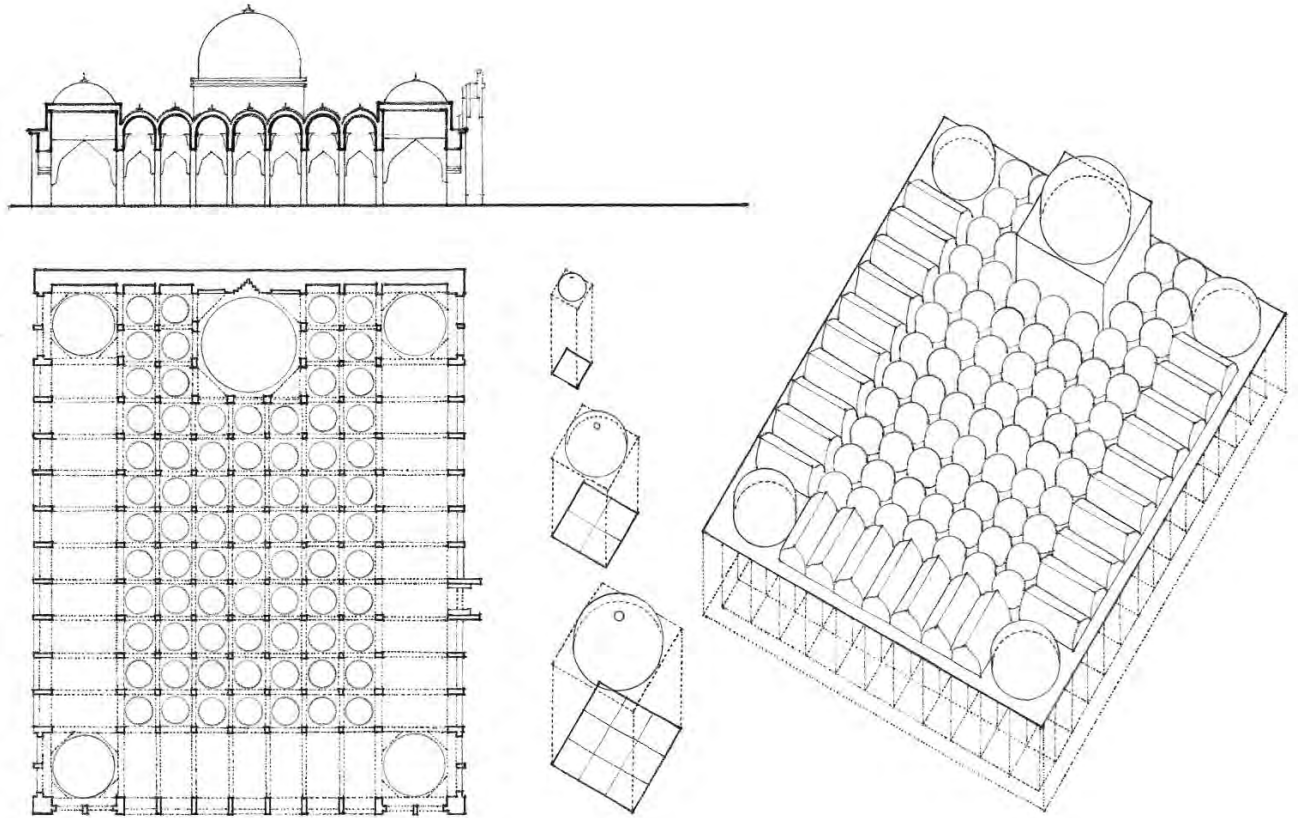
Jami Masjid, *Gulbarga, India, 1367*
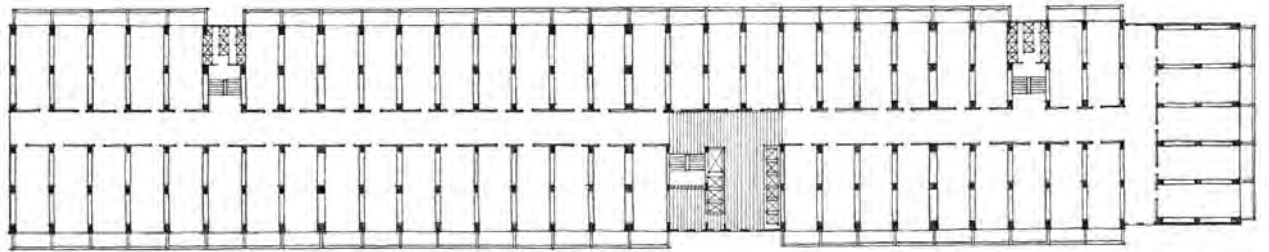
Typical Floor Plan, **Unité d'Habitation**, *Marseilles, 1946–52, Le Corbusier*
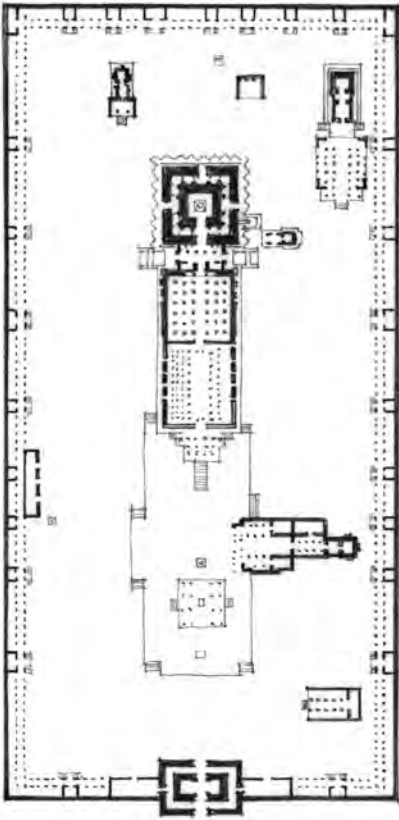
Dakshinameru (**Rajarajeshwara Temple**), Thanjavur, India, late 10th century
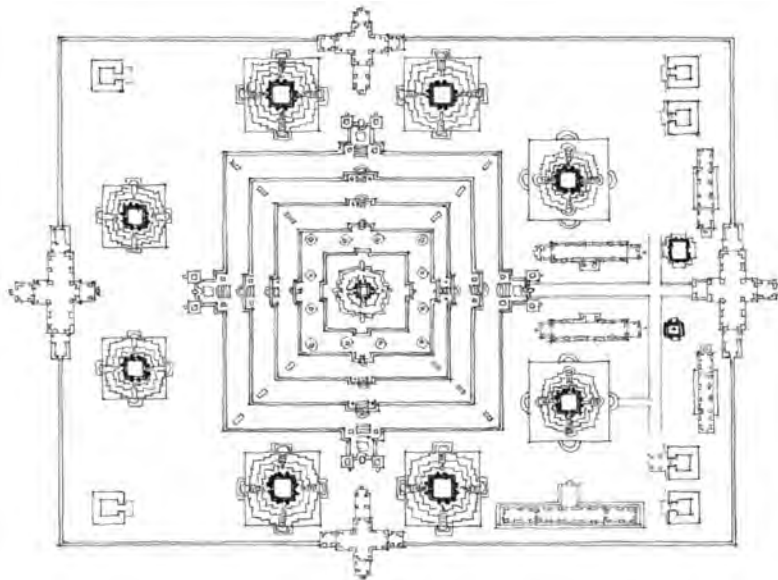
Bakong Temple, near Siem Reap, Cambodia, c. A.D. 881
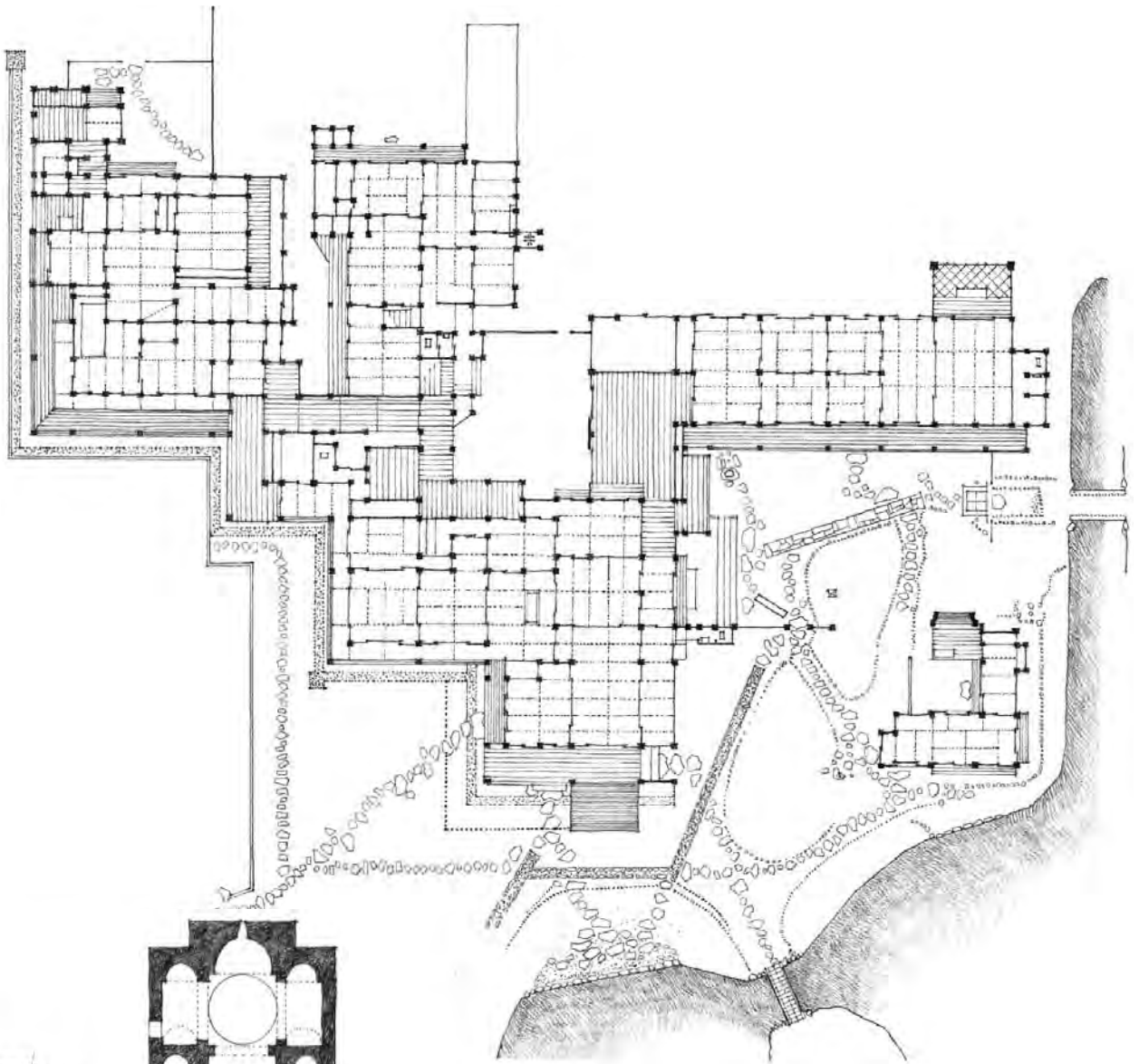
Katsura Imperial Villa, Kyoto, Japan, 17th century
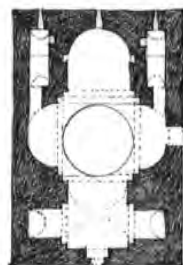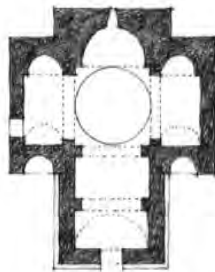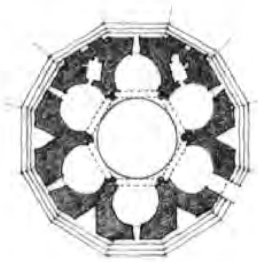
Typology of 6th-century Armenian churches
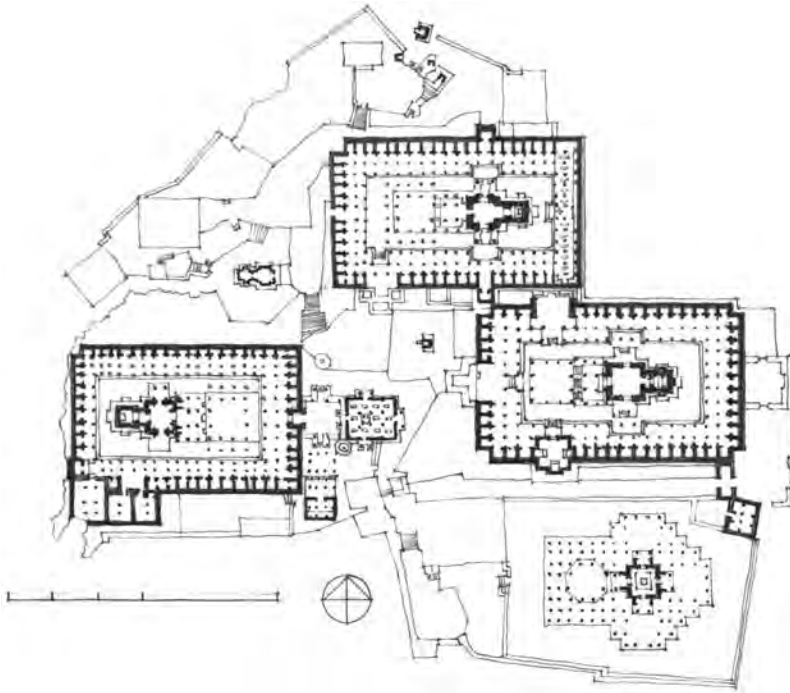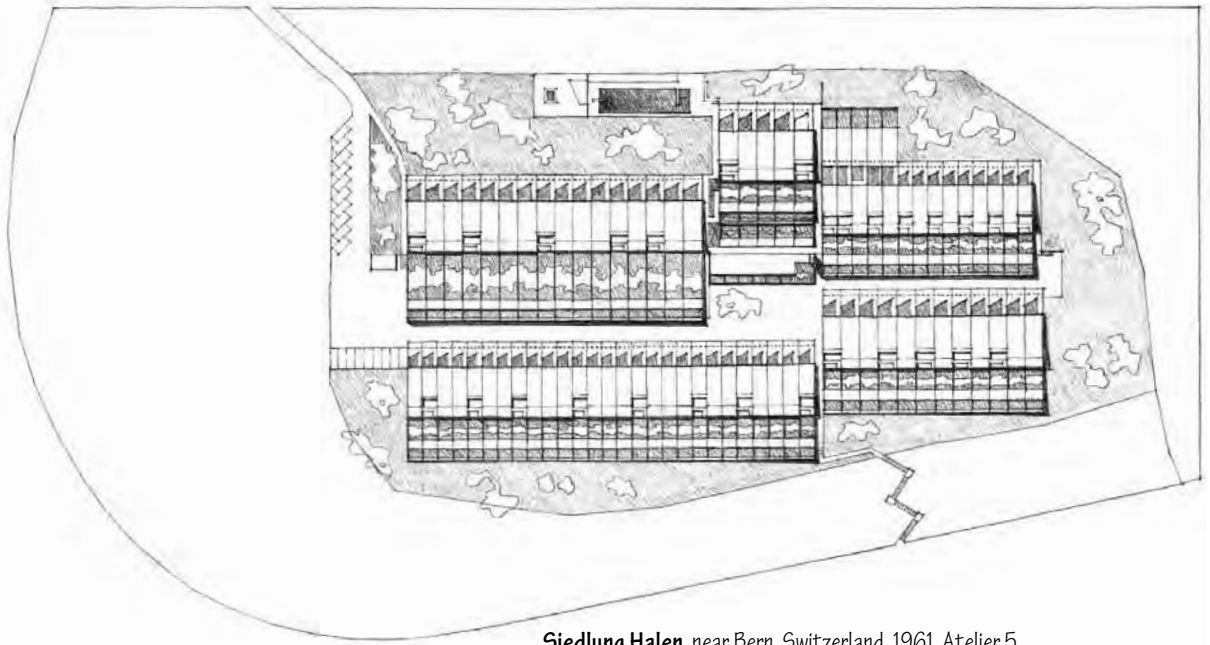
Jain Temples at Mt. Abu, India, 11th–16th centuries
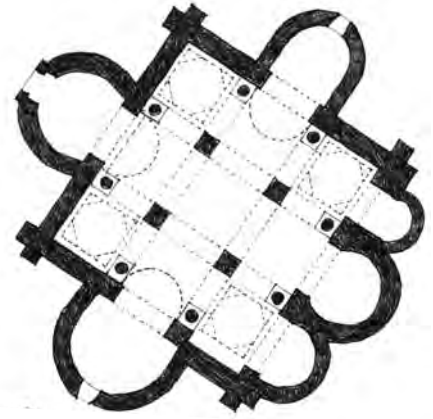
Germigny-des-Prés, France, 806–11, Oton Matsaetsi

As in music, a rhythmic pattern may be legato, continuous, and flowing, or staccato and abrupt in its pace or cadence.
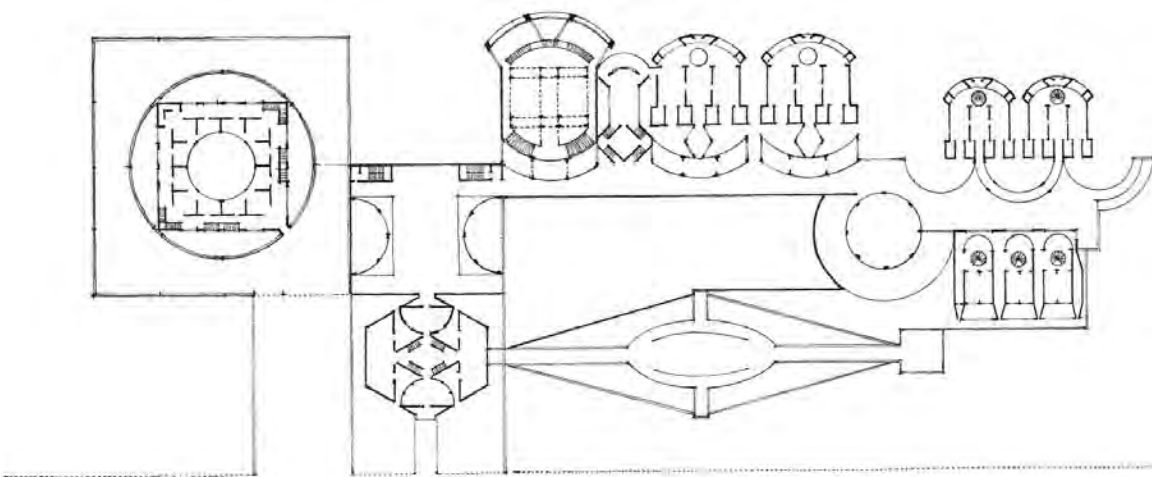
Capitol Complex (Project), **Islamabad**, Pakistan, 1965, Louis Kahn

Siedlung Halen, near Bern, Switzerland, 1961, Atelier 5

Residential fabric of 1st-century **Pompeii**
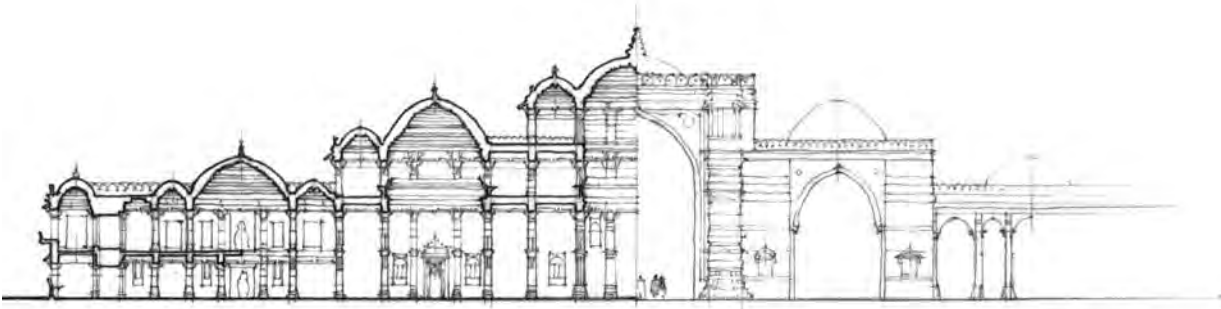
Section through main prayer hall: **Jami Masjid of Ahmedabad**, India, 1423
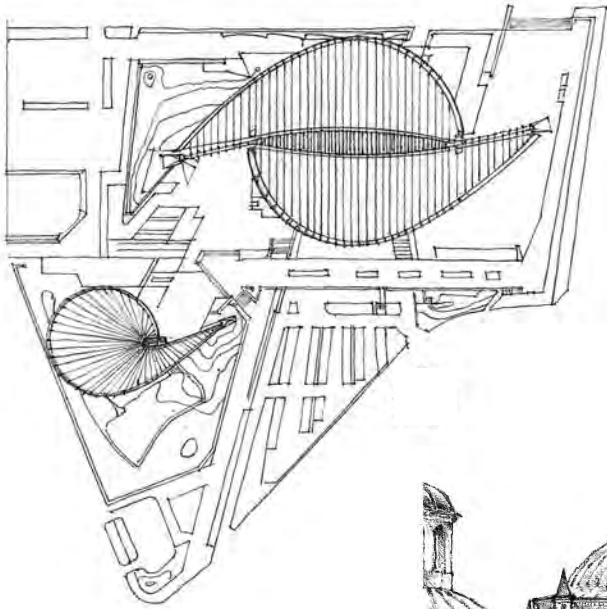
Olympic Arena, Tokyo, Japan, 1961–64, Kenzo Tange
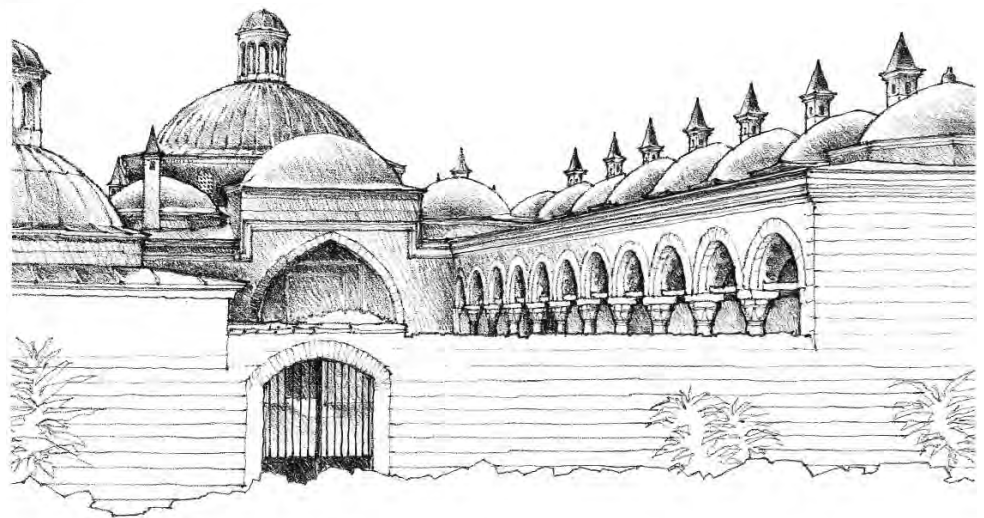
Rhythmic patterns provide continuity and lead us to anticipate what comes next. Any break in the pattern announces and emphasizes the importance of the interrupting element or interval.

Külliye of Beyazid II, Bursa, Turkey, 1398–1403
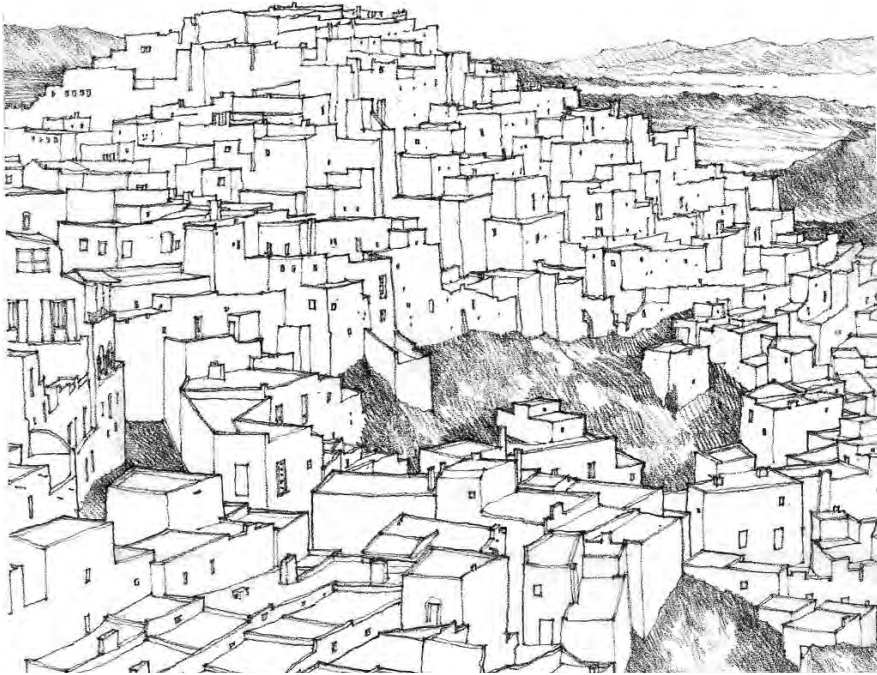
*View of Spanish Hill Town of **Mojácar***
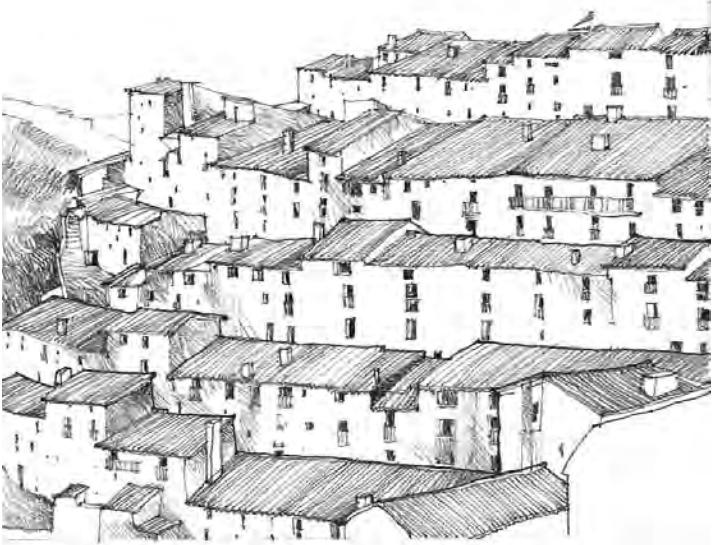
*View of **Villa Hermosa**, Spain*

Rhythm created by connecting points in space
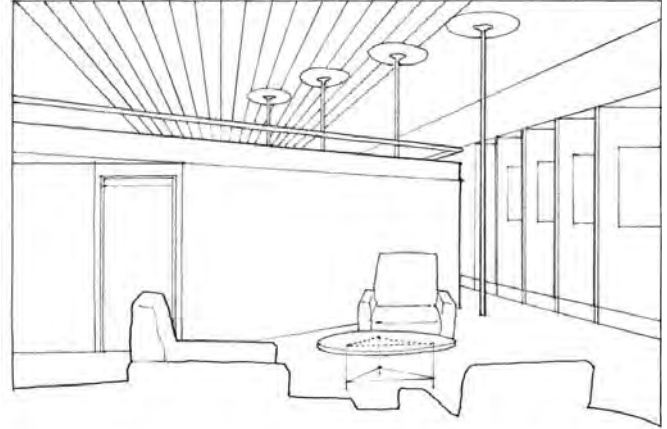
Contrasting rhythms
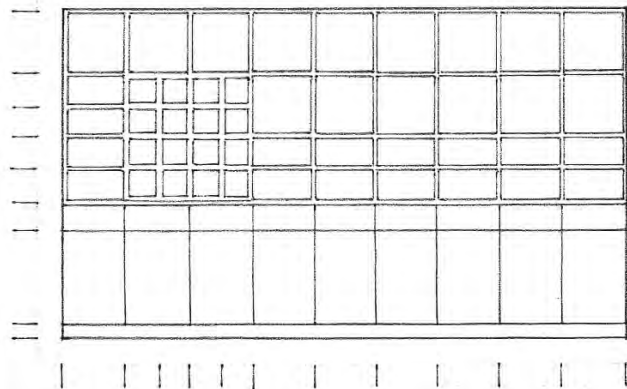
Horizontal and vertical rhythms
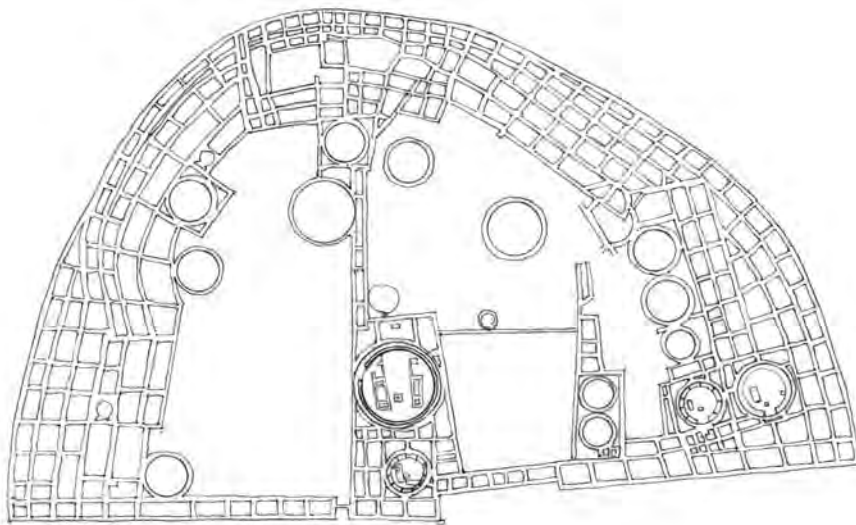
Pueblo Bonito, Chaco Canyon, USA, 10th–13th centuries
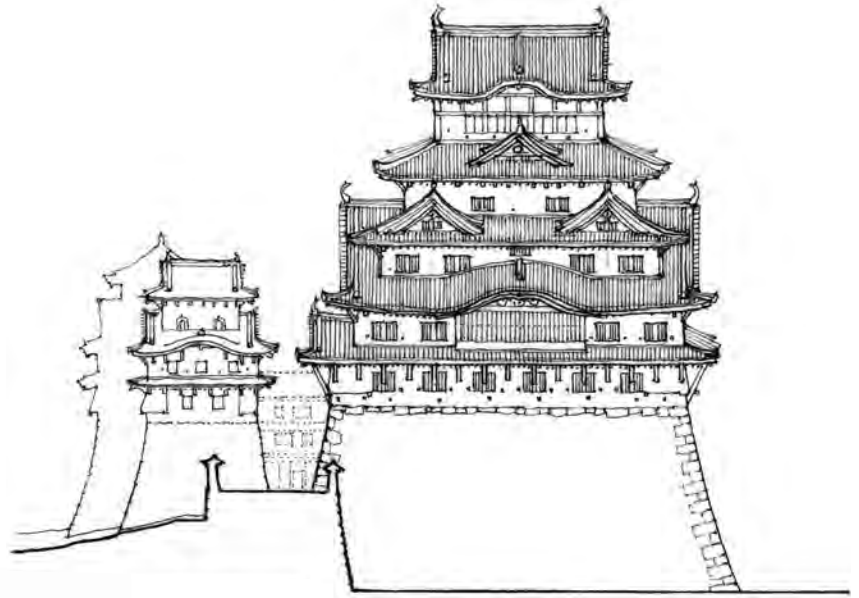
Himeji Castle, Himeji, Japan, begun 1577
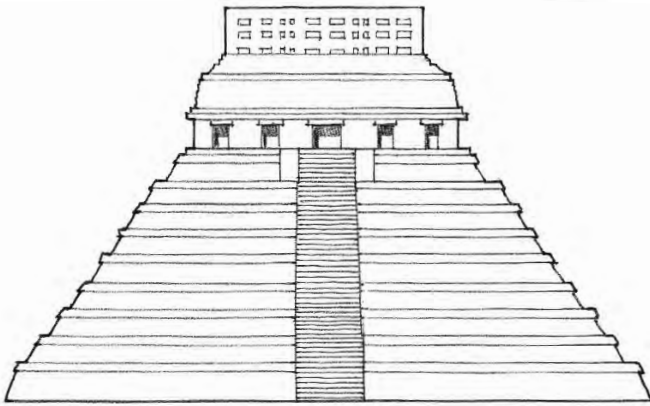
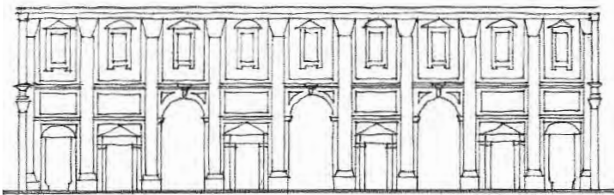**Temple of the Inscriptions**, Palenque, Mexico, c. A.D. 550
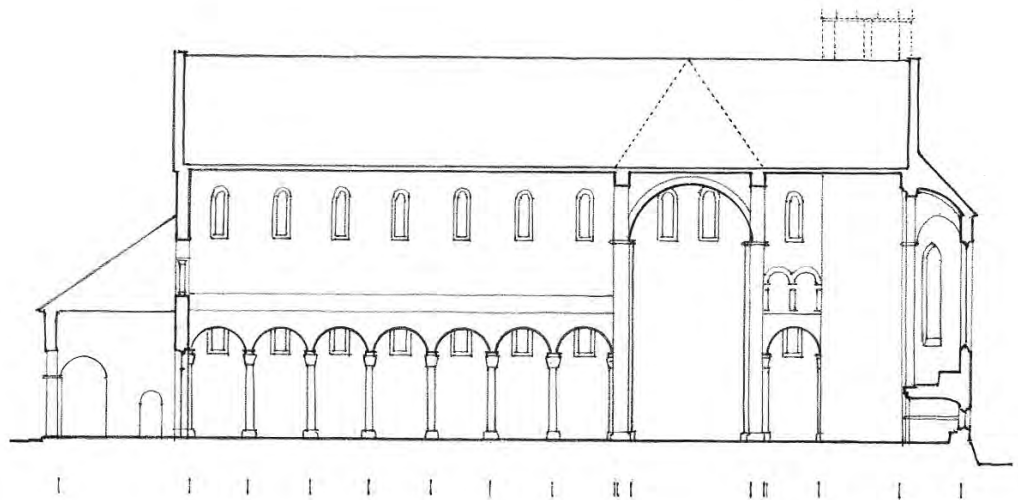
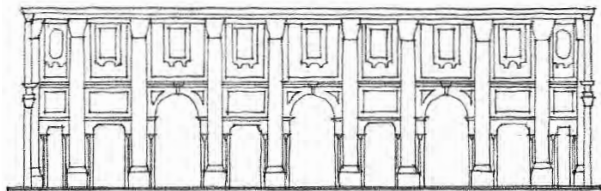**Abbey Church at Alpirsbach**, Germany, c. 1000
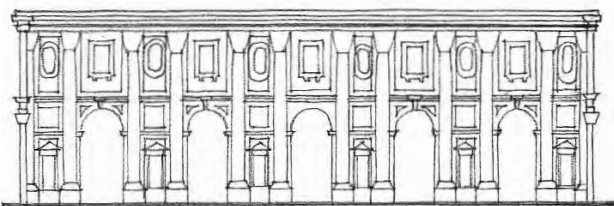
Victorian Facades fronting a San Francisco street

Multiple rhythms can be laid over one another in the facade of a building.

a · b · a · b · a · b · a · b · a..........
a · a · b · a · b · a · b · a · a..........
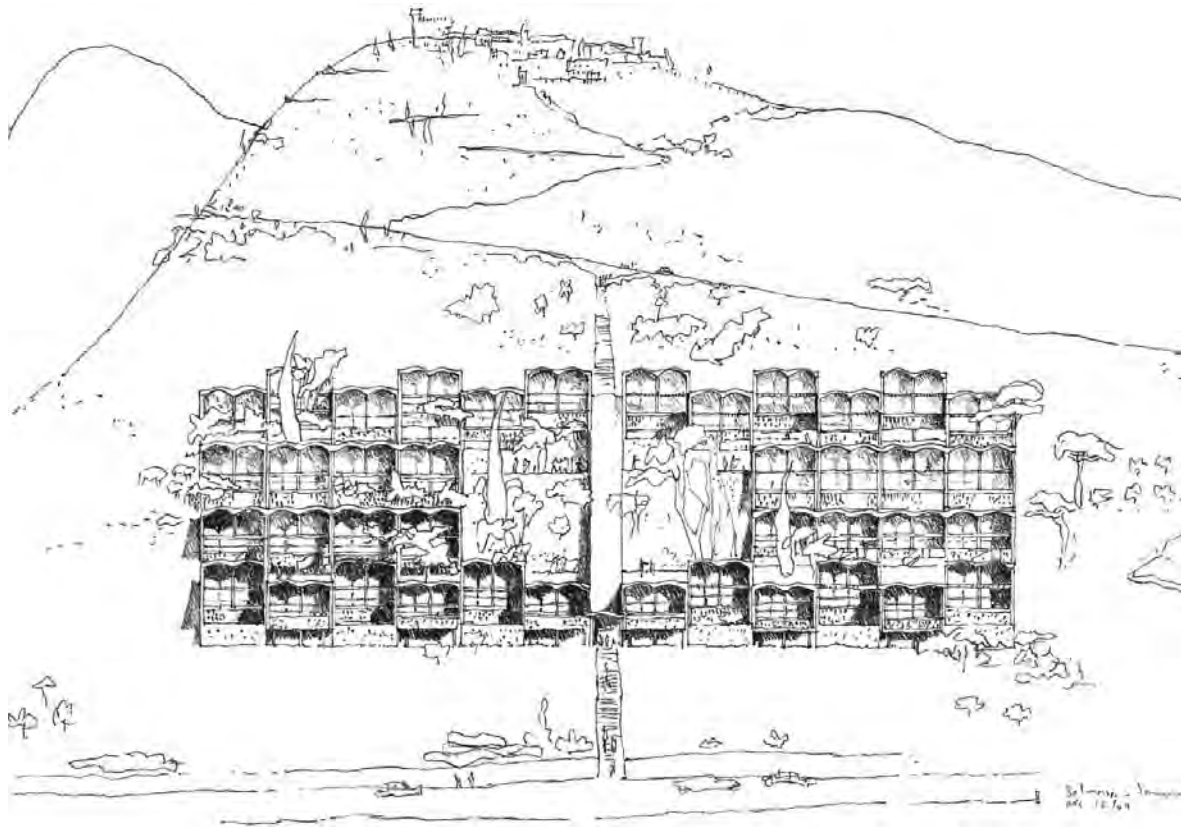A · B · C · B · C · B · C · B · A..........

a · b · b · b · b · b · b · b · a..........
c · a · b · a · b · a · b · a · c..........
A · B · C · B · C · B · C · B · A..........

a · b · a · b · a · b · a · b · a · b · a......
a · b · a · b · a · b · a · b · a · b · a......
A · B · A · B · A · C · A · B · A · B · A......

Studies of **Internal Facade of a Basilica** by Francesco Borromini

Roq Housing Project, Cap-Martin, on the French Riviera near Nice, 1949, Le Corbusier

More complex rhythmic patterns can be created by introducing points of emphasis or exceptional intervals into a sequence. These accents or beats help differentiate between the major and minor themes in a composition.

**Bedford Park**, London, 1875, Maurice Adams, E.W. Goodwin, E.J. May, Norman Shaw
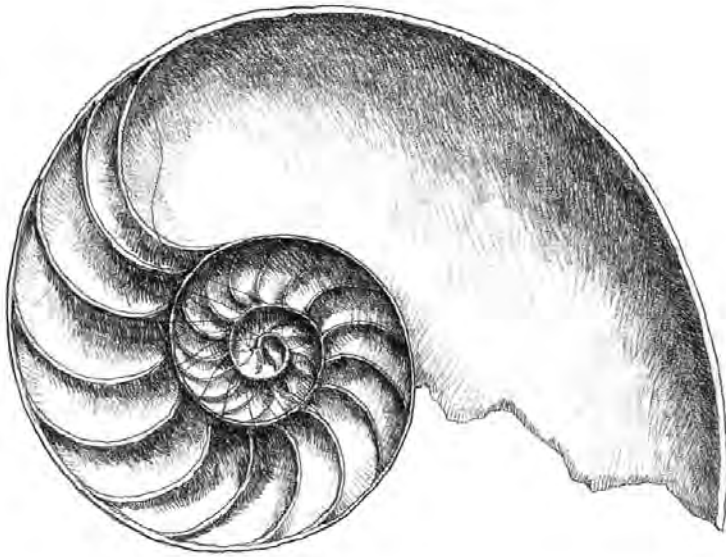
The radial segments of a nautilus shell spiral outward in a reverberating manner from its center and maintain the shell's organic unity through this pattern of additive growth. Using the mathematical ratio of the Golden Section, a series of rectangles can be generated to form a unified organization wherein each rectangle is proportionate to the others as well as to the overall structure. In each of these examples, the principle of reverberation creates a sense of order among a group of elements which are similar in shape but hierarchically graded in size.

Progressive, reverberating patterns of forms and spaces can be organized in the following ways:

• in a radial or concentric manner about a point
• sequentially according to size in a linear fashion
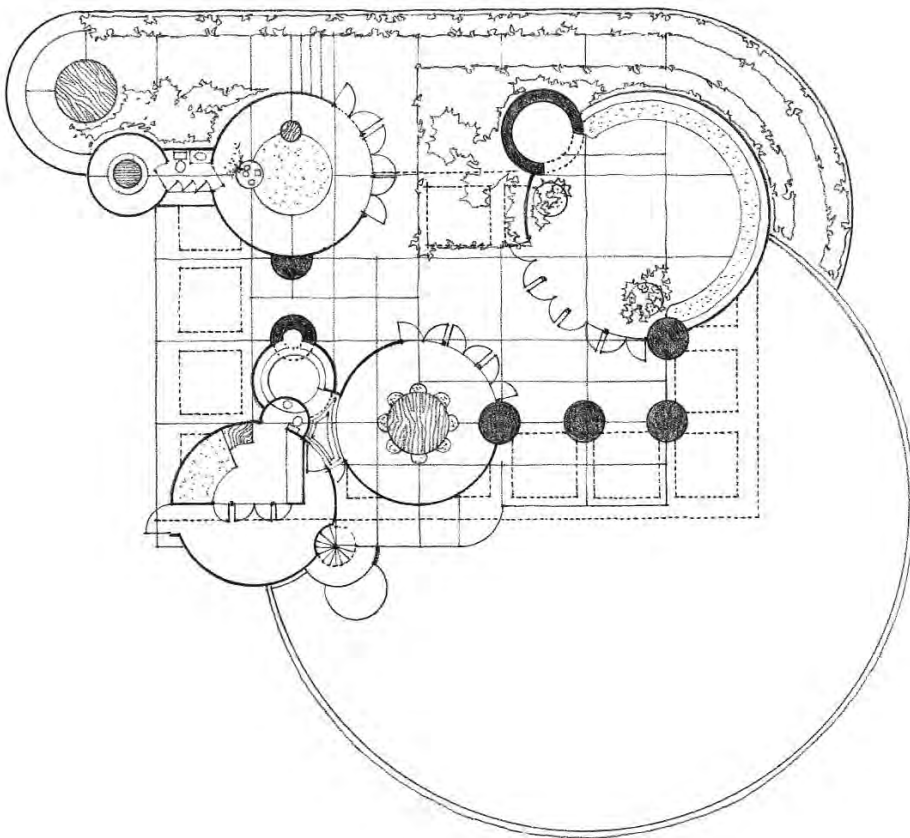• randomly but related by proximity as well as similarity of form
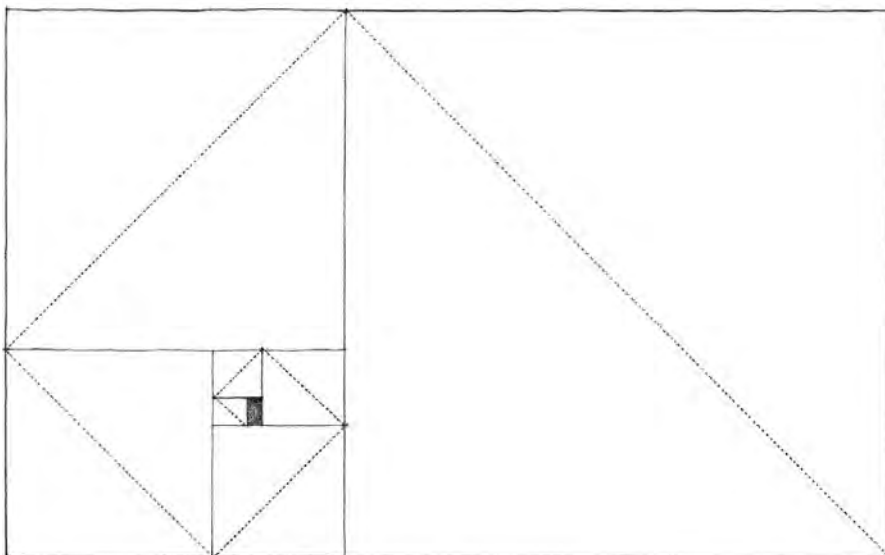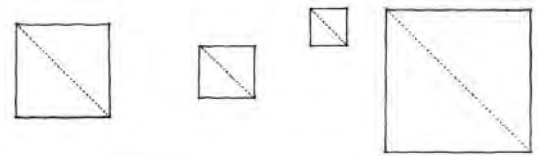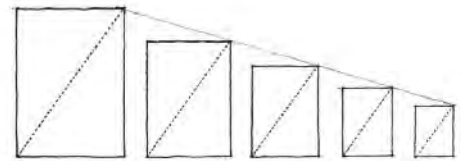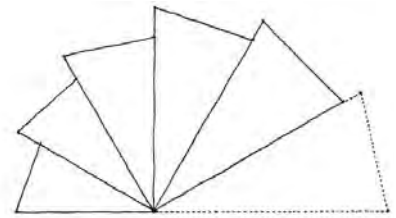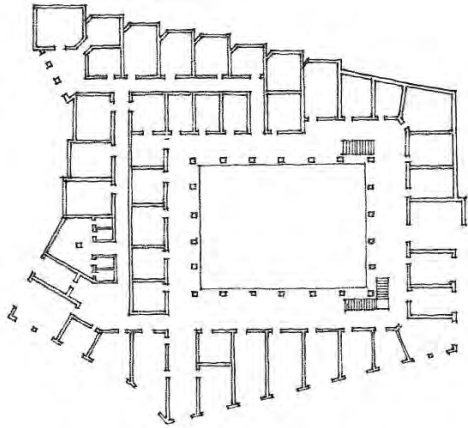
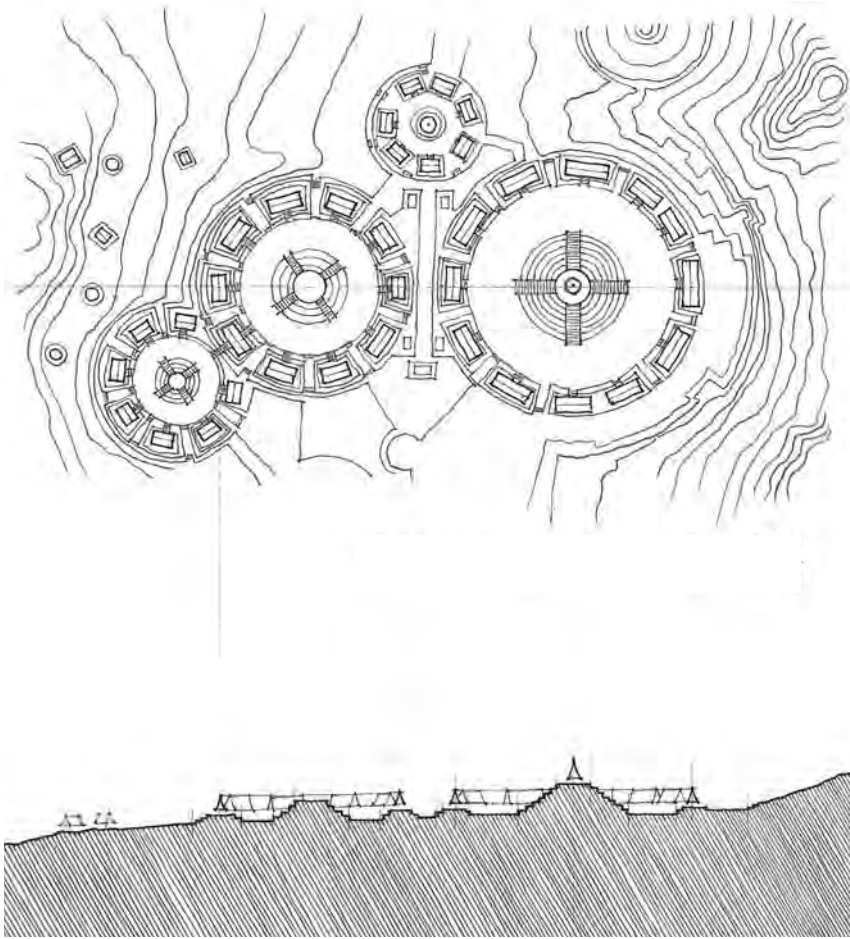**Hasan Pasha Han**, Istanbul, 14th century
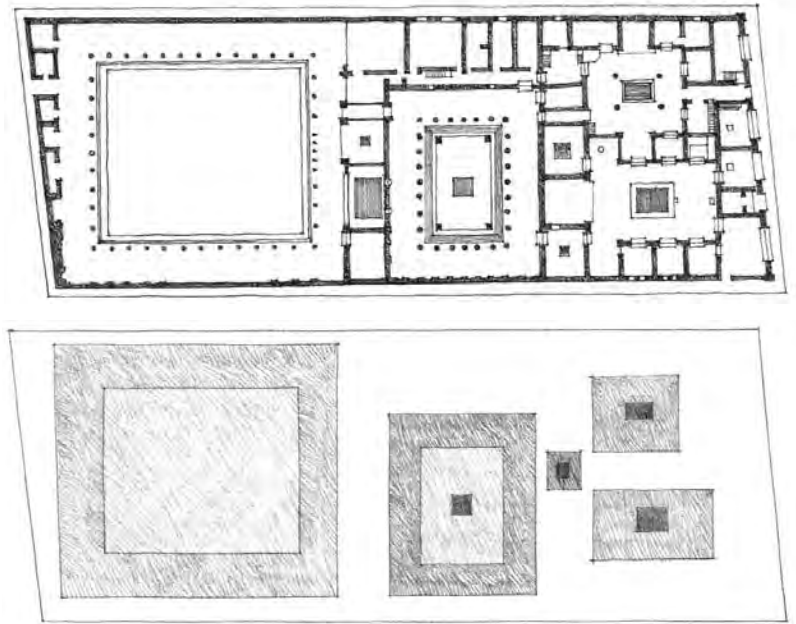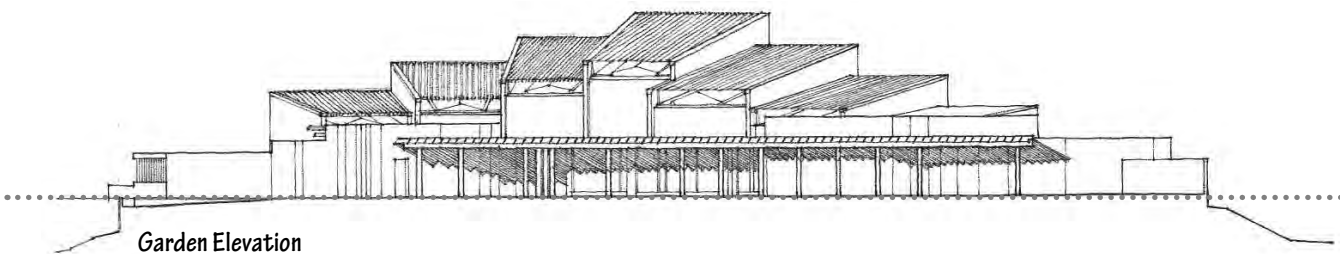

House of the Faun, Pompeii, c. 2nd century B.C.

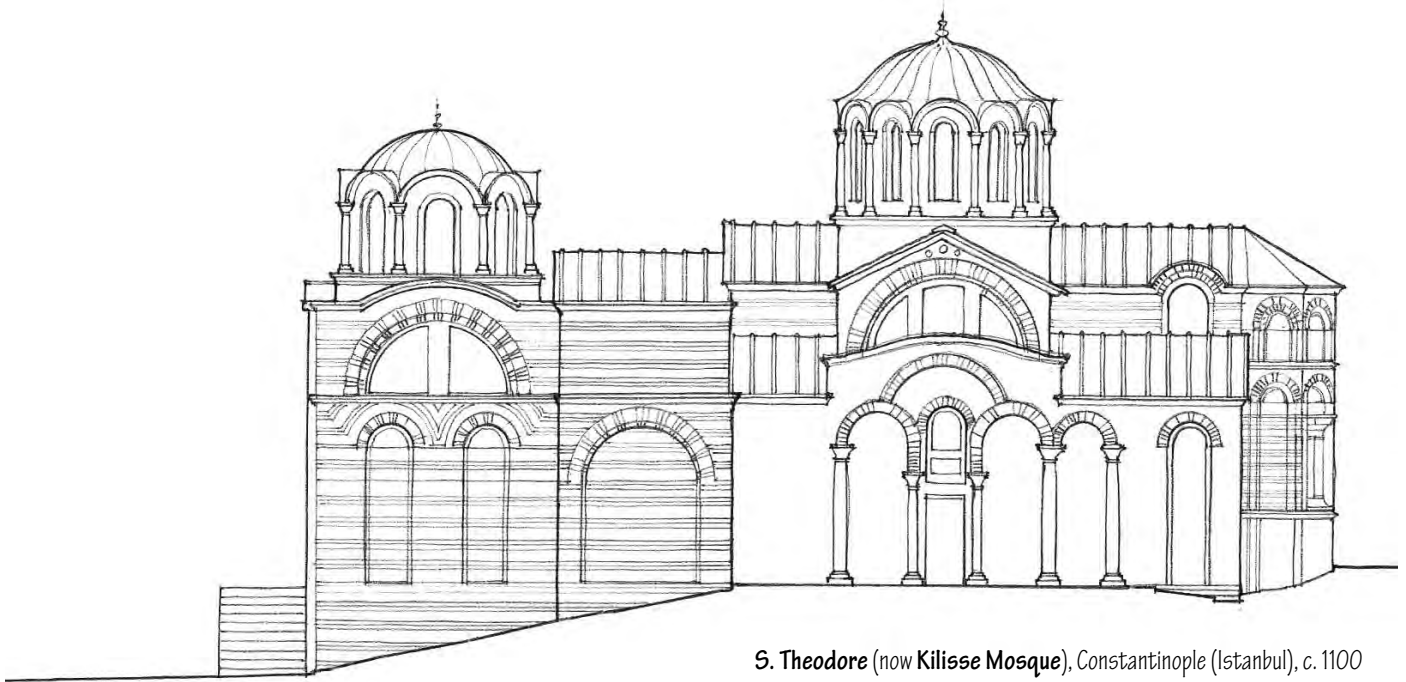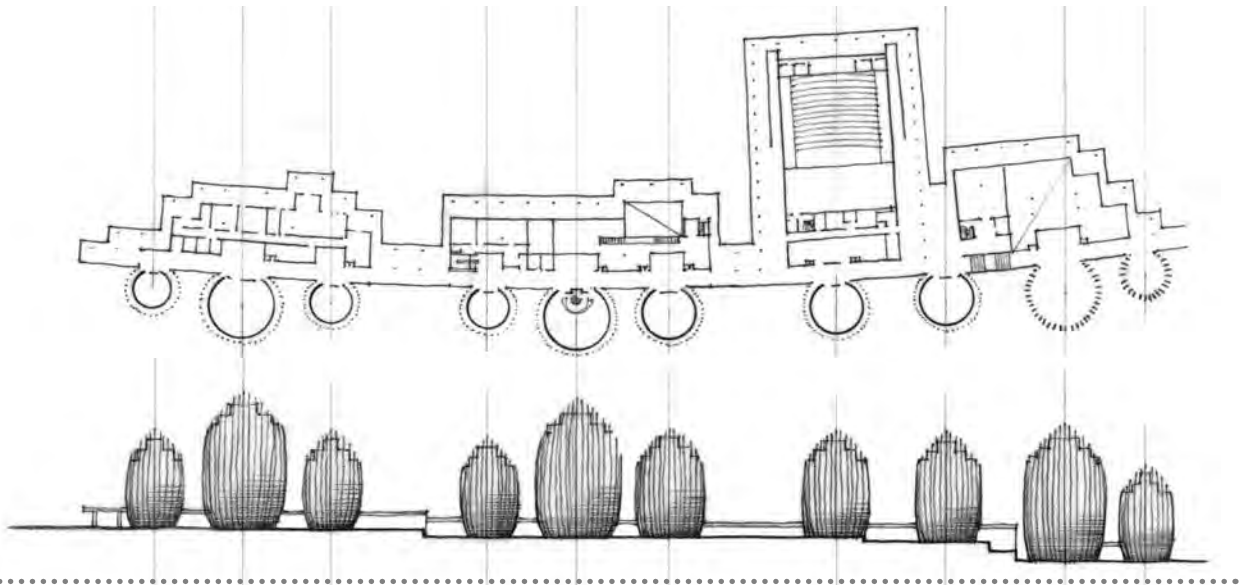**Jester House** (Project), Palos Verdes, California, 1938, Frank Lloyd Wright

Plan and section: Central circular structures of the **Guachimonton complex** at Teuchitlán, A.D. 300–800

Garden Elevation

Art Gallery, **Shiraz**, Iran, 1970, Alvar Aalto

S. Theodore (now **Kilisse Mosque**), *Constantinople (Istanbul), c. 1100*
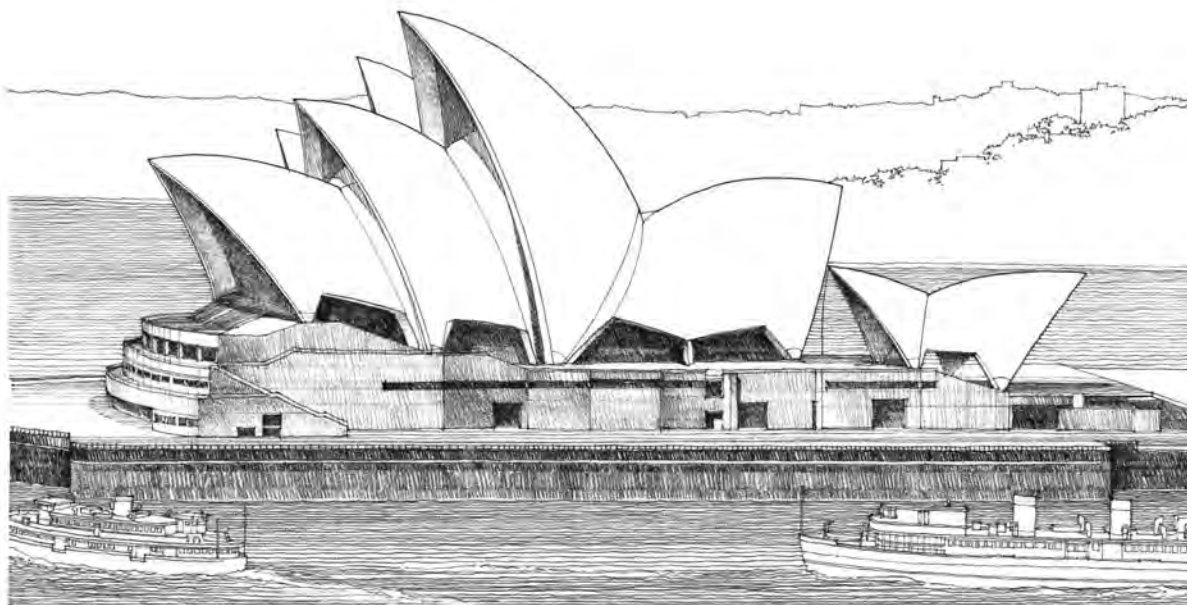

Can Lis, *Porto Petro, Majorca, 1973, Jørn Utzon*

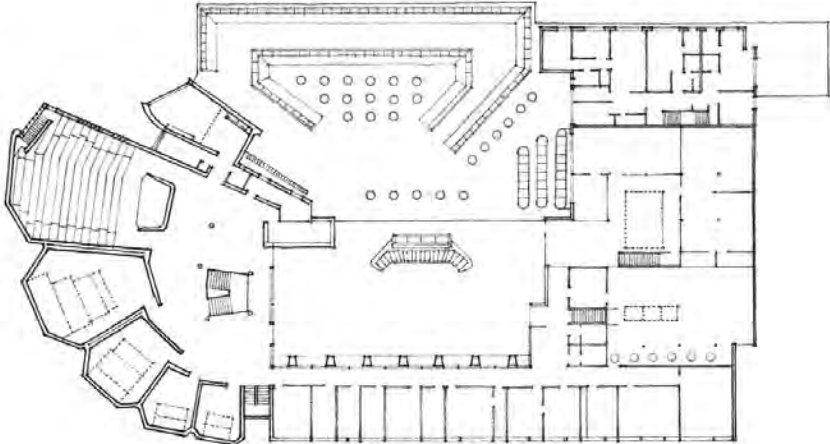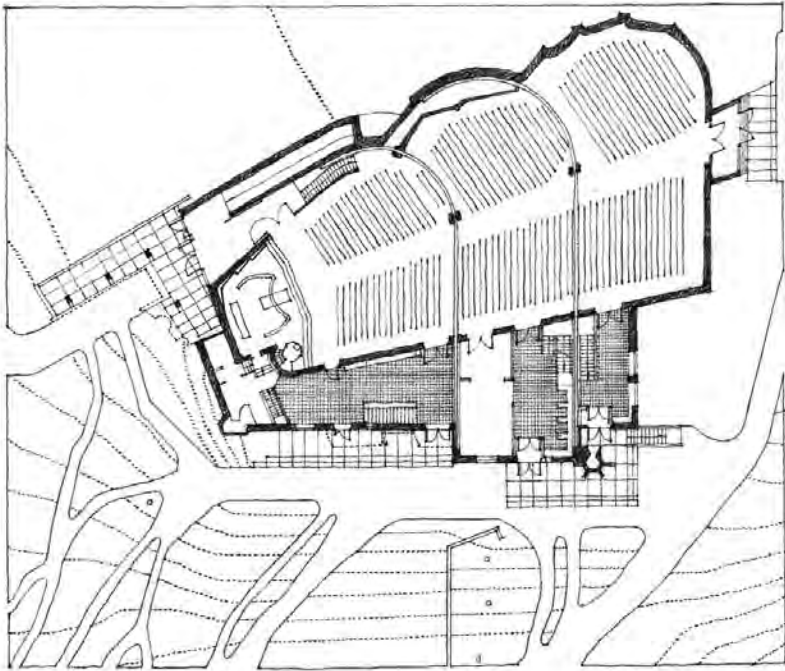**Sydney Opera House**, Sydney, Australia, designed 1957, completed 1973, Jørn Utzon
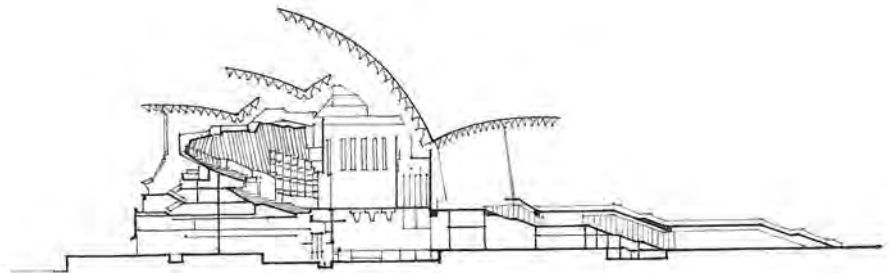
Section
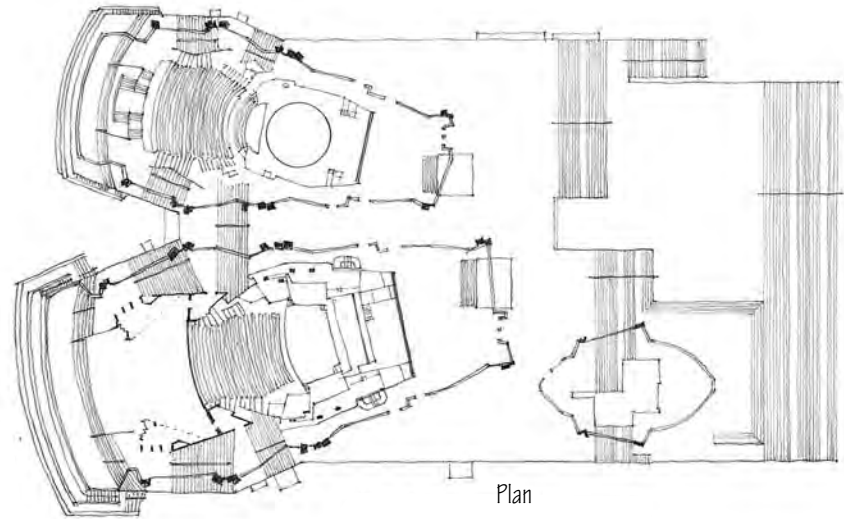
Plan

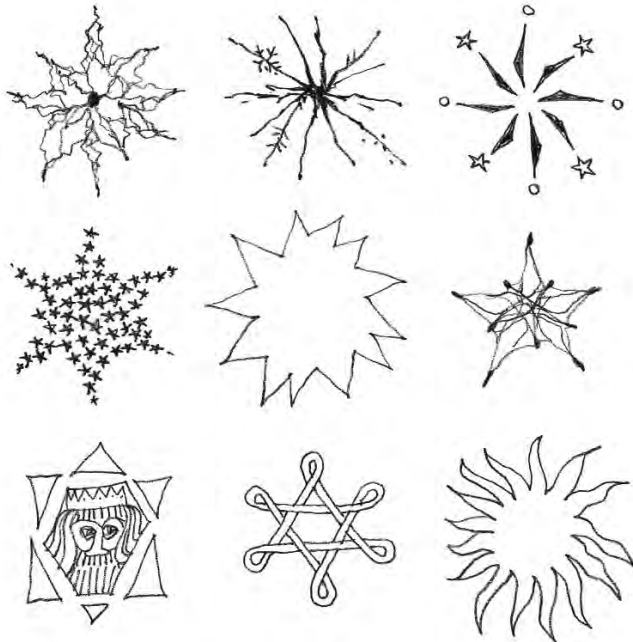**Cultural Center**, **Wolfsburg**, Germany, 1948–62, Alvar Aalto
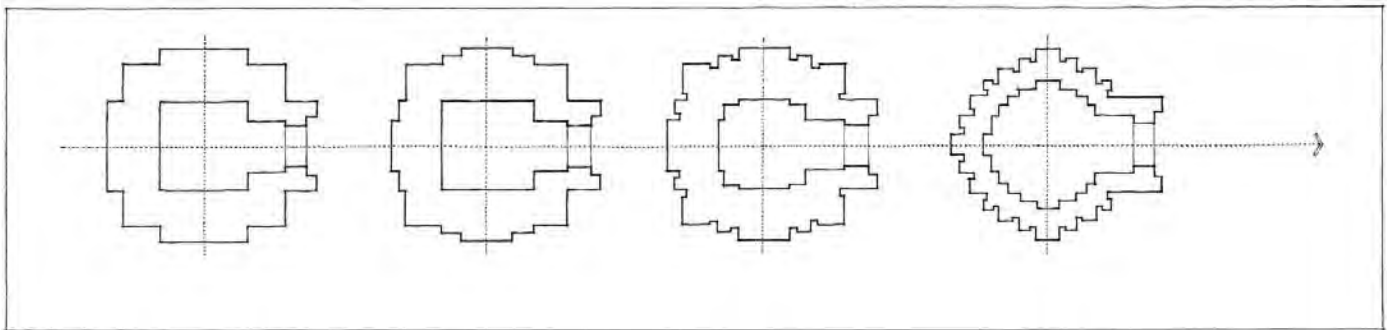

Plan

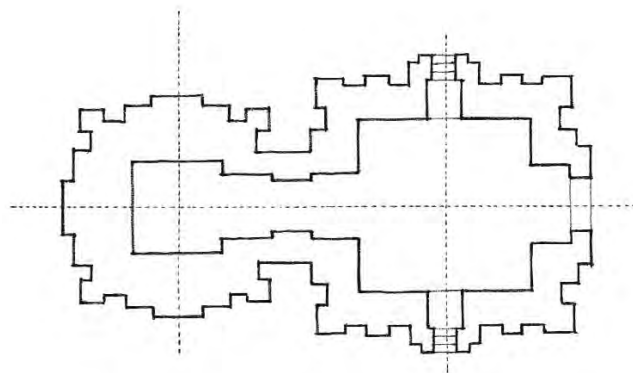**Church at Vuoksenniska**, Finland, 1956, Alvar Aalto

The study of architecture, as with other disciplines, should legitimately involve the study of its past, of prior experiences, endeavors, and accomplishments from which much can be learned and emulated. The principle of transformation accepts this notion; this book, and all of the examples it contains, is predicated on it.

The principle of transformation allows a designer to select a prototypical architectural model whose formal structure and ordering of elements might be appropriate and reasonable, and to transform it through a series of discrete manipulations in order to respond to the specific conditions and context of the design task at hand.
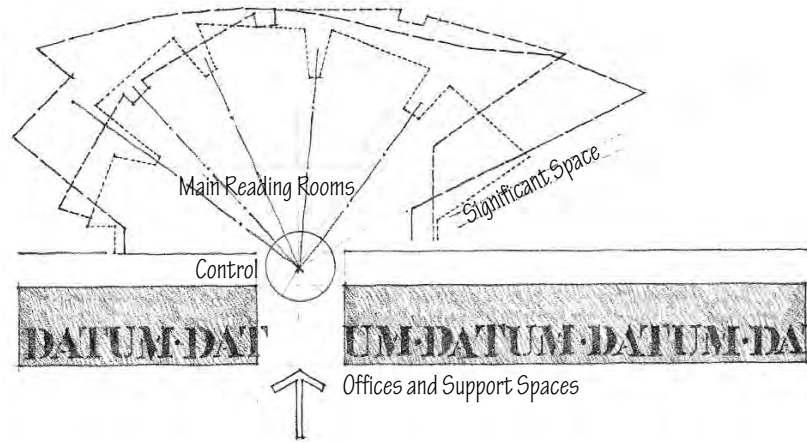
Design is a generative process of analysis and synthesis, of trial and error, of trying out possibilities and seizing opportunities. In the process of exploring an idea and probing its potential, it is essential that a designer understand the fundamental nature and structure of the concept. If the ordering system of a prototypical model is perceived and understood, then the original design concept can, through a series of finite permutations, be clarified, strengthened, and built upon, rather than destroyed.
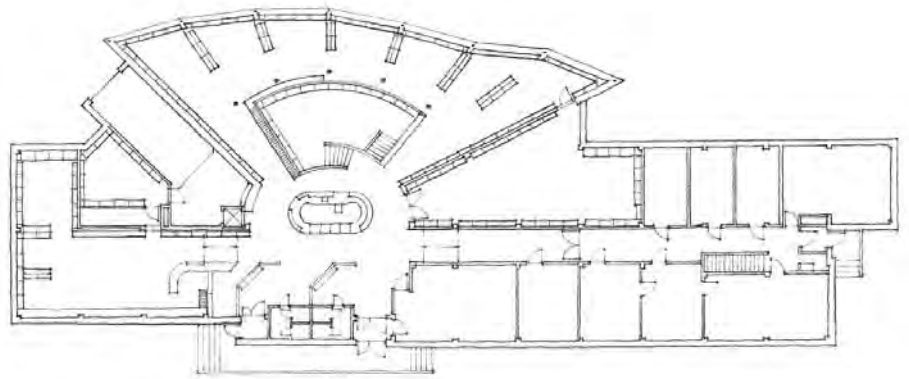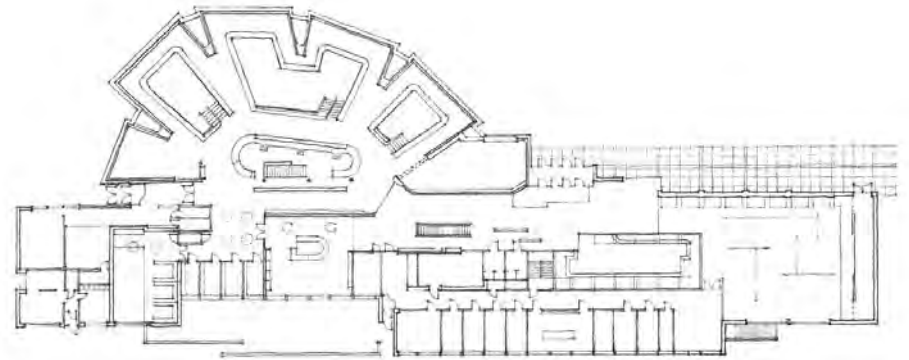

Plan Development of the **North Indian Cella**
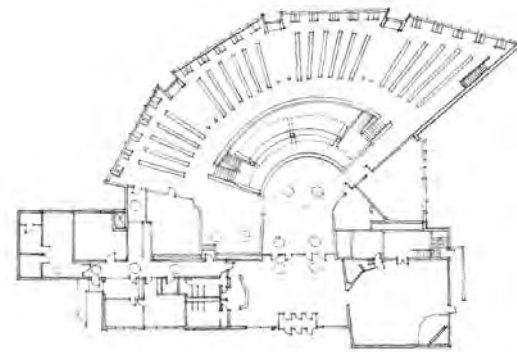
Scheme for 3 libraries by Alvar Aalto

Main Reading Rooms

Significant Space

Control

DATUM·DAT UM·DATUM·DATUM·DA

Offices and Support Spaces

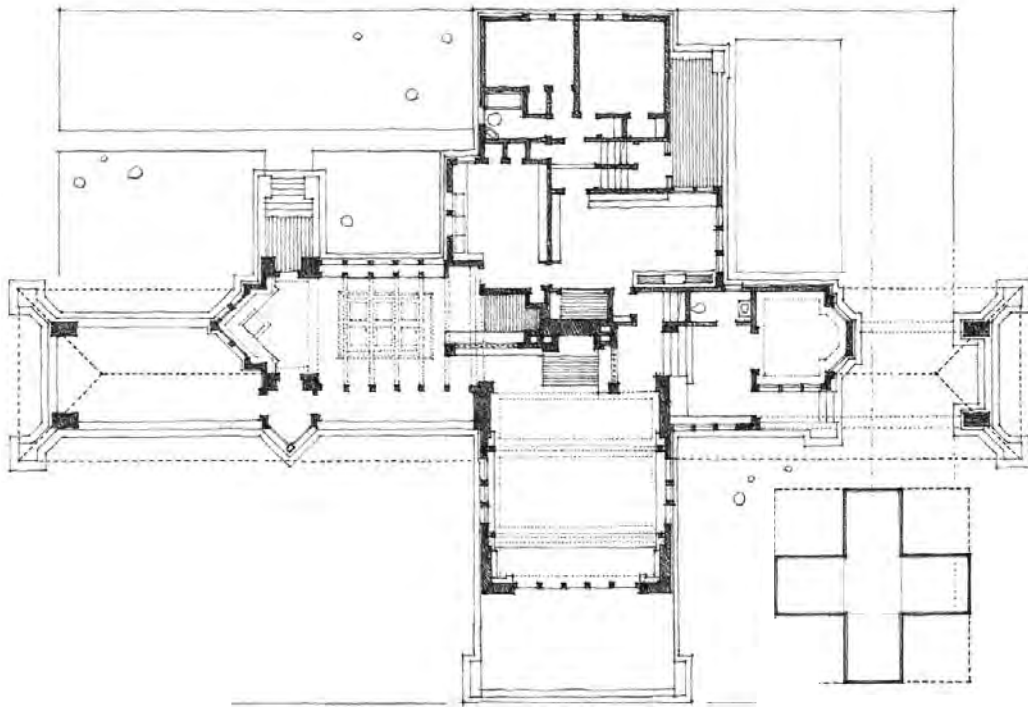**Library of Mount Angel**, Benedictine College, Mount Angel, Oregon, 1965–70

Library, **Seinäjoki**, Finland, 1963–65
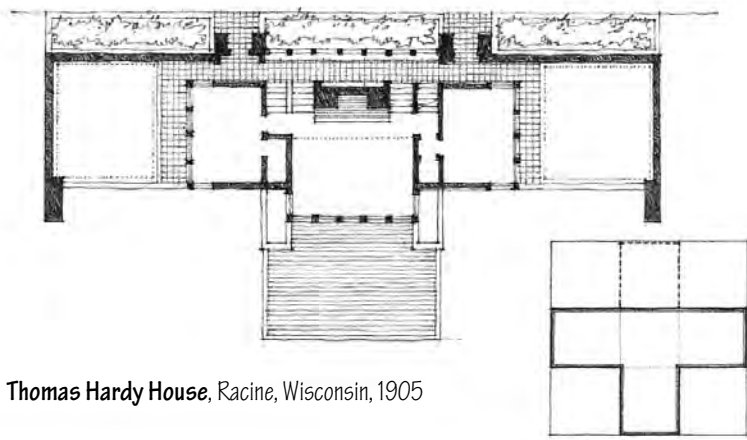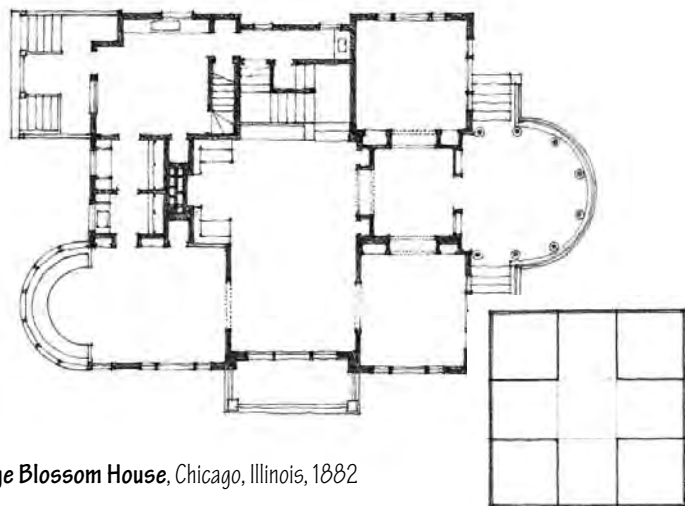
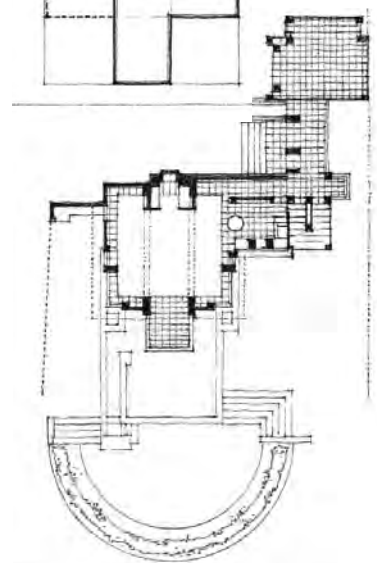**Library**, **Rovaniemi**, Finland, 1963–68

Ward Willetts House, Highland Park, Illinois, 1902

Transformation of a **Cruciform Plan Organization** by Frank Lloyd Wright
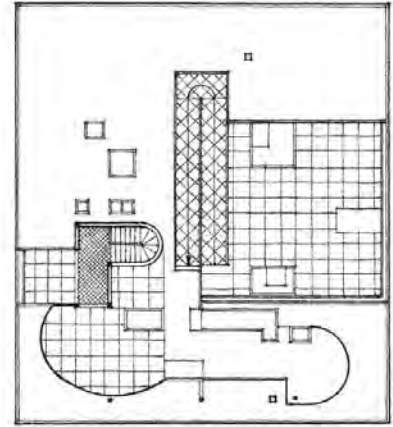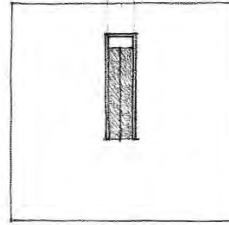
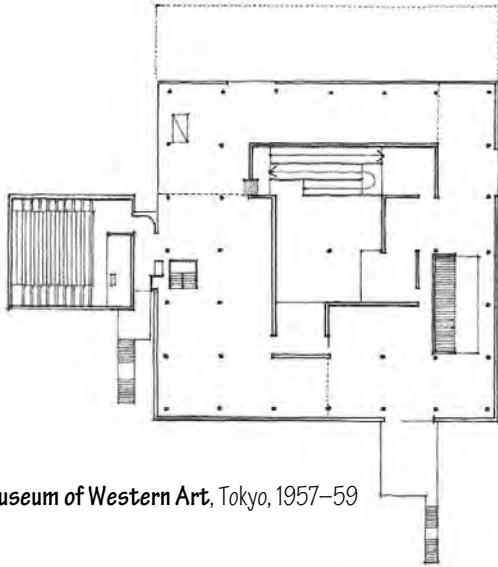**Thomas Hardy House**, Racine, Wisconsin, 1905
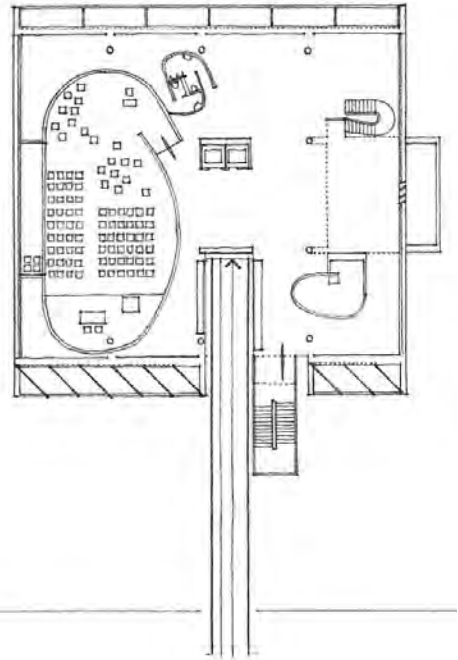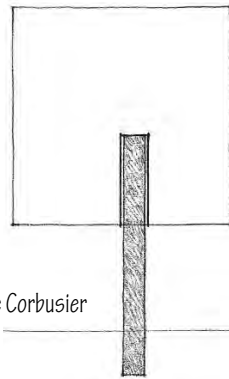
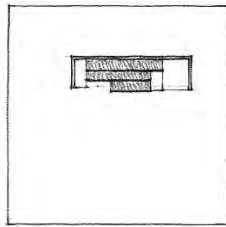**George Blossom House**, Chicago, Illinois, 1882

Samuel Freeman House, Los Angeles, California, 1924
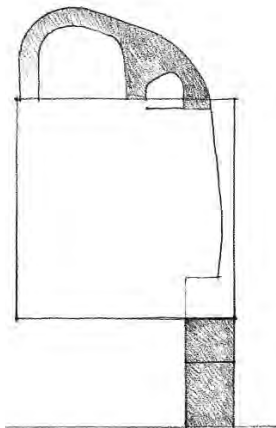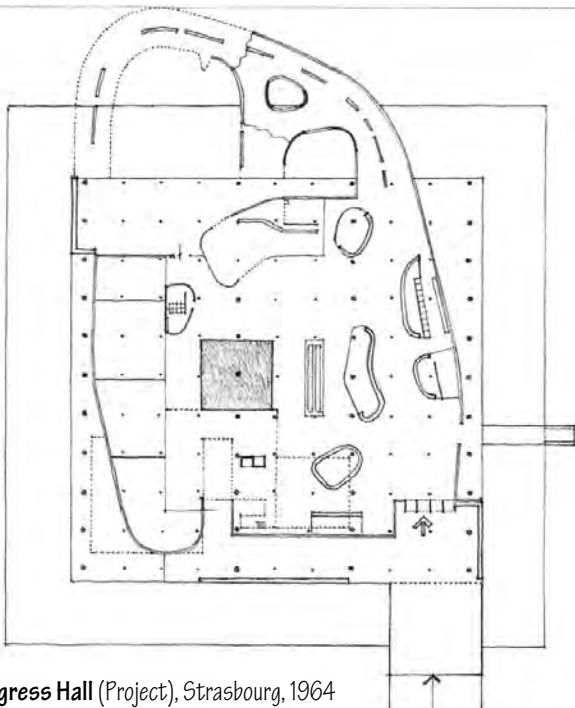
Villa Savoye, Poissy, France, 1928–31

Museum of Western Art, Tokyo, 1957–59

Transformation of a Free-Plan Organization, **the Ramp-in-a-Square**, by Le Corbusier

Millowners' Association Building, Ahmedabad, India, 1954

Congress Hall (Project), Strasbourg, 1964